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Attorney for Plaintiff

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF PENNSYLVANIA

ROBERT J. KRAUS and MARGARET M. KRAUS, h/w	:CIVIL ACTION : :
vs.	:NO. 18-CV-2119 :
ALCATEL-LUCENT, et al.	:ASBESTOS CASE

ANSWER TO MOTION OF LOCKHEED MARTIN TO EXCLUDE

ARTHUR FAHERTY

Lockheed has failed to meet its burden on this motion. It should be denied.

PAUL, REICH & MYERS, P.C.

By: Robert E. Paul

ROBERT E. PAUL

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MEMORANDUM OF LAW

Kraus served on the USS Cambria from 1964-1967. Later he worked for GE in its 32nd and Chestnut Streets location. During his service on the Cambria he was near repairs to Lockheed's SPS-40. The SPS- 40 was like all electronic equipment [1]. Such equipment on the Cambria contained resistors and capacitors (Exhibit B, Gossett). In the period of Kraus' Navy service the standard practice was use of asbestos for such equipment (Exhibit C documents) which was opened monthly as part of preventive maintenance (Exhibit B, Gossett). When the equipment was opened it made dust that had to be vacuumed out from the deteriorated internal components (Exhibit B, Gossett, Exhibit D, Kraus). Kraus testified that the biggest things on the ships were the radars (24). His men worked on radios, transmitters and receivers. There was periodic maintenance (26) as described by Gossett this was monthly. The equipment was on racks which were removed and taken to the shop (20). The equipment also needed clearing (30-31). The overhaul process was completely done in Philadelphia (178). The SPS-40 broke down

[1] Lockheed made this inquiry more difficult by destroying the Technical Manual for the SPS-40 which did exist as late as 1998 (Exhibit A). This manual would have provided information on what was contained in the equipment.

all the time and had to be modified (210, 215). Lockheed's agent came out to work on the SPS-40 (210)[2]. During that employment GE and RCA made similar electronic equipment used on the Cambria that had to be handled in the same way (Exhibit E). Later Kraus worked for GE in a building filled with asbestos (Exhibit F, Covalevski). Sometime later the GE Aerospace division which succeeded RCA and GE and included Chestnut Street assets were sold to Lockheed's predecessor. GE asserts Lockheed is responsible for the Aerospace division assets, Lockheed asserts GE is still responsible. For the purpose of this motion it will be assumed Lockheed is liable for both its own products and the GE/RCA ones.

Faherty is a graduate of the Merchant Marine Academy, a licensed marine engineer, a former professor of Naval subjects, and a contractor hired by the Navy to repair and clean out ships removing asbestos and a reviewer of naval specifications for many years. As such he is qualified to opine on the subject (see resume and report, Exhibit) for which he is offered:

1) Navy specifications on warnings.
2) Asbestos content and likelihood of electronic equipment on ships releasing asbestos dust when handled based on his own experience of removing dust
3) Results of handling asbestos on ships based on hypotheticals from the transcript and documents he has previously reviewed of GE and RCA and Lockheed and those which will be part of the record.
4) asbestos composition of products
5) likelihood of exposures to Lockheed on GE/RCA

---

[2] Lockheed had the original SPS-40 later versions belonged to other manufacturers, see Exhibit A.

6) codefendants notes that these products give off dangerous amounts of asbestos (Exhibit I)

He has reviewed many of the documents concerning equipment on the Cambria and the depositions of the witnesses. As even Lockheed concedes he has personal experience in reading documents and content of electronic equipment, as well as the relevant manuals for shipboard equipment on the Cambria. He has actually removed the resistors from ships. He is thus able to assist the jury in interpreting the manuals and Navy specifications at issue and in understanding the composition of the products to which Kraus was exposed.

Lockheed's arguments mirror many of the argument of co-defendants and all of the answers to the motion to exclude Faherty, Frank and Spector are incorporated by reference under FRCP 10. If Lockheed is liable for GE than the ship aspects of the answer to GE's motion applies and is incorporated pursuant to F.R.C.P. 10.

PAUL, REICH & MYERS, P.C.

By: ______________________________
ROBERT E. PAUL

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF PENNSYLVANIA

ROBERT J. KRAUS and MARGARET M. KRAUS, h/w	:CIVIL ACTION :
	:
vs.	:NO. 18-CV-2119
	:
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ORDER

AND NOW, to wit, this _________ day of _____________, 2020, **Lockheed Martin's** Motion to Exclude Arthur Faherty is hereby **DENIED**.

BY THE COURT:

____
J.

CERTIFICATE OF SERVICE

The undersigned certify that a true and correct copy of the within Plaintiff's answer to Lockheed Martin's Motion to Exclude the testimony of Arthur Faherty has been filed electronically. This document is available for viewing and downloading from the ECF system and was served upon all counsel of record.

Robert E. Paul

Robert E. Paul

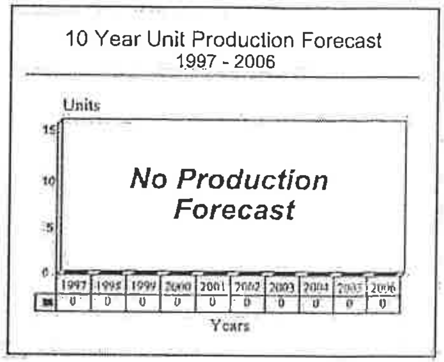
Date: January 16, 2020

EXHIBIT A

SPS-40(V) - Archived 5/98

Outlook

- Production complete
- Upgrades and spares support continue
- Multi-element upgrades will extend operational life into the next century



Orientation

Description. Shipborne search radar.

Sponsor

US Navy
Naval Sea Systems Command (NAVSEA)
2531 Jefferson Davis Highway
Arlington, Virginia (VA) 22202
USA
Tel: +1 703 602 3381

Contractors

Northrop Grumman Corp
Electronic Sensors & Systems Division
10 Norden Place
Norwalk, Connecticut (CT) 06856
USA
Tel: +1 203 852 5000
Fax: +1 203 852 7698
[formerly Westinghouse Electronic Systems Group, Norden Systems]
(Prime: Development/Production)

Northrop Grumman Corp
Electronic Sensors & Systems Division
P.O. Box 17319
Baltimore, Maryland (MD) 21203-7319
USA
Tel: +1 410 765 1000
Fax: +1 410 993 8771
[formerly Westinghouse Electronic Systems Group]
(Solid-State Transmitter Upgrade)

Status. System production complete; upgrades and spares support.

Total Produced. Estimated total production was 156 systems. Modification production continues.

Application. Surface combatants.

Price Range. Undetermined.

Technical Data

	Metric	US
Dimensions		
Antenna		
Weight:	785 kg	1728 lb

information on low-flying aircraft that were in the SPS-40 and SPS-40A blind spot.

SPS-40C/D. These solid-state variants add reliability enhancements and combine most of the earlier model features. The SPS-40C went into service in the early 1970s and included the LFDM modification. The SPS-40D was an improved version of the -C. Both exhibited a 40-percent improvement in reliability and maintainability over the earlier systems.

SPS-40E. This is an SPS-40 with the Westinghouse SSTX modification. It has become the standard version of the SPS-40 for the Fleet.

Program Review

Background. Originally developed by Lockheed Electronics, the SPS-40 was introduced into US Navy service in the early 1960s as a replacement for the SPS-31. It was designed for destroyers, but came to be used on numerous classes of ships. It has subsequently been fitted in ships of other navies from South America, Europe and the Middle East.

The Navy deployed ships with the Solid State Transmitter to the Persian Gulf and Red Sea during Operation Desert Storm. In this combat environment, operators reported superior reliability and performance stability from the systems. A hoped-for major retrofit of the SPS-40E to many ships was canceled due to lack of funding.

In February 1996, the Navy announced that it intended to issue a solicitation for integration of the SPS-48E radar with the SYS-2 Integrated Automatic Detection Tracking System (IADT) and for integrating the SPS-40E Radar with the SYS-2(V) (IADT). The specifications for the computer systems were: Motorola Power PC Model, MVME 1604-023, 133 MHz; CPU, MPC 604; Memory Dram, 32 Mb; Memory Flash, 1 Mb; Memory Cashe, 256 Kb; Ethernet Interface; SCSI Interface; Graphics Output; Four Serial I/O; and One Parallel I/O.

Acquisition of the Motorola brand name power personal computer systems was essential to the government's requirements, precluding consideration of a product manufactured by another company. The intended Motorola source has the only verified and validated hardware which could execute the existing tactical software. Therefore, the acquisition would be issued on a sole-source basis.

Generic Simulator Program. In March 1995, the Naval Sea Systems Command announced that they were conducting a market survey to identify sources to provide Generic Navy Stimulators/Simulators (GNSS). The GNSS is to be built to Open System Architecture (OSA) standards incorporating a functionally modular design using Non-Developmental Items and Commercial Off-The-Shelf products as well as industry-defined software and communication interface standards. An overall objective in the design and development of the GNSS is to provide the Navy with the most cost-effective system which makes maximum use of the inherent Battle Force Tactical (BFTT) System capabilities, while allowing as much flexibility as possible for future growth.

According to the *Commerce Business Daily* announcement, the government will solicit plans to develop, manufacture, install and maintain standardized radio frequency (RF) and intermediate frequency (IF) Stimulators and Digital Simulators for the Surface Navy, on a variety of surface platforms. The GNSS shall consist of a GNSS controller Versa Module Eurobus (VME) and a ship-specific number (1-6) of Radar Signal Generator enclosures capable of producing, either by stimulation or simulation, modeled radar return signals and/or video signals associated with the following radar sets: AIMS MK XII IFF; SPN-35; SPN-43; SPN-46; SPQ-9B; SPS-40 Series; SPS-48 Series; SPS-49 Series; SPS-55 Series; SPS-67 Series; TPX-42; UPX-29; UPX-30; UPX-36; MK 23 TAS; and MK 95 NSSMS.

The Navy anticipated issuing a final RFP in May 1996 with a Cost Plus Incentive Fee development and test contract award in Fall 1996. The contract would contain fixed price options for five subsequent years of production equipment. In addition, product improvement engineering and engineering support would be procured throughout the contract's period of performance.

Funding

US FUNDING

	FY96		FY97		FY98 (Req)		FY99 (Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
Procurement (USN)								
SPS-40	-	0.0	-	7.5	-	0.7	-	0.0

All US$ are in millions.

KRAUSTOLMC01349

Recent Contracts

No contracts over US$5 million recorded.

Timetable

Jun	1961	Initial systems delivered
	1990	US Navy initiated SPS-40 upgrade
	FY92	Receiver modifications complete
	FY94	SSTx transmitter deliveries, current contract complete
	FY96	Antenna restoration program complete

Worldwide Distribution

In service with **Australia, Brazil, Germany, Greece, Japan, Pakistan, Turkey** and the **United States.**

Forecast Rationale

Although the SPS-40 is an old system, upgrades, enhancements, and repairs have kept it operational and capable. Enhancements capitalized on newer technology to maintain radar performance at an acceptable level.

The Solid State Transmitter was one of the radar's most important upgrades. The transmitter of a high-powered radar is its weak link and the redesigned power amplifiers eliminate this source of trouble, making "fail-soft" the usual failure mode, instead of the sudden, complete failure typical of tube transmitters. In the "fail soft" mode, performance degrades gradually should one or more solid-state components fail. This prevents total loss of surveillance capability and allows the system to operate while repairs are being made.

The solid state components are more cost-effective and maintenance costs are lower. Because budget constraints make it necessary to maintain operations as long as possible with successful equipment, the SPS-40 can plan on a long life on the ships carrying it. Other enhancements and repairs, such as a series of receiver and data processing upgrades and the replacement of many antenna assemblies, are combining with the new transmitter to give the fielded SPS-40s a long life expectancy. Most should remain operational as long as the ship carrying it is active. The Navy continues to seek information on possible upgrades and improvements. Newer systems with more modern designs are available. These include the SPS-48(V) and SPS-49(V); but the Navy continues to deploy a sizable number of surface combatants equipped with the SPS-40C/D/E.

The Navy is involved in upgrade programs for the receiver, receiver signal processor and a solid state transceiver. Many antennas are being replaced. This will extend the operational life of the system. Support will continue for those systems at sea.

Ten-Year Outlook

No more production expected.

* * *

Dimensions:	3 X 5.5 m	18 X 9.75 ft
Below-decks equipment		
Weight:	1,576 kg	3,474 lb

Characteristics

Frequency:	400 to 450 MHz
Channels:	10
PRF:	278 to 300 pps
Peak Power:	125 to 225kW
Range:	225 nm (max)
Pulse Width:	3 µsec 60 µsec (compressed 60:1)
Antenna Beam Width:	11° X 19°
Scan rate:	7.5 or 15 rpm
Scan period:	4 or 8 seconds
Clutter Improvement factor:	54 dB 66 dB with Doppler Processor)
Track initiation:	Automatic
Track File Size:	511
MTBF:	200 hr (SPS-40D/E)

Design Features. The SPS-40 is a two-dimensional air search and surveillance radar used by surface ships to detect airborne targets at long and medium ranges. The system was specifically designed for long range surveillance and uses standard search radar operational techniques: MTI; frequency jitter; pulse compression; and several receiver and processor control techniques to enhance detection capabilities.

The most significant change to the radar has been the introduction of a Solid-State Transmitter (SSTx). This replaced the system's old tube-type transmitter, significantly enhancing reliability. The new system uses redundancy and interchangeability to insure maximum reliability and ease of maintenance. The SSTx was designed to degrade gradually and gracefully should components fail, insuring that the radar remains operational in spite of the problem and while repairs can be accomplished.

The SSTx can adjust the output power so Emission Control (EMCON) operations are possible; but it is capable of instantly resuming full power operation from the EMCON state on command of the operator. The transmitter can also adjust to high reflected energy caused by battle damage to the antenna or waveguide.

The system is available in a half-power version for ships involved in coastal operations that require shorter-range sensors. The Solid State Driver cabinets are combined with existing Power Amplifier cabinets to form a single-unit PA configured transmitter instead of two cabinets.

Other receiver, processor and antenna improvements are being considered to update the SPS-40 with new technology. The latest receiver upgrade includes an enhanced signal-to-noise ratio through optimum signal processing. The radar is equipped with interfaces to feed radar data into the ship's combat control system.

Operational Characteristics. Like the SPS-49, the SPS-40 is a standard air surveillance radar for the surface fleet. It is found on many older combatants and auxiliaries and supports long-range target detection and tracking, self-defense and fire control system designation. The radar will detect aircraft at long ranges in a variety of sea states, providing early warning of the approach of aircraft and has good range resolution to detect multiple missile raids.. It is IFF capable for air traffic control and threat identification operations.

The system detects, within limits, the approach of low-flying targets. The radar incorporates a variety of electronic counter-countermeasures to insure effective operation in hostile electronic environments. Frequency agility and side-lobe reduction are ECCM features under development. IT was designed to have a limited vulnerability to Anti-Radiation Missiles.

Variants/Upgrades

SPS-40B. This version uses a 3 µsec pulse, 300 pps PRF, Digital MTI, low-flying-target detection mode (LFDM), automatic target detector and various ECCM improvements. Some systems had a Minimum Range Modification (MRM) that provided range and bearing

AN/SPS-40 Surface Search Radar

Manufacturer: Northrop Grumman Norden Systems
The AN/SPS-40 is the primary shipboard long-range, high-powered, two-dimensional (2D), surface and air search radar for detection of targets at long and medium ranges. It provides 10-channel operation, moving target indicator (mti), pulse compression, and high data short range mode (SRM) for detecting small, low-altitude, close-in targets. The AN/SPS-40B baseline (which includes the B, C and D radars) is designed to provide optimum performance capabilities with minimum operator interface. Special features of the AN/SPS-40B include long-range resolution and accuracy, light weight and flexible packaging for easy shipboard installation, field proven high reliability, maintainability and availability. The UHF(B) band operating frequency provides freedom from weather clutter and low vulnerability to anti-radiation missiles. The system's digital moving target indicator provides excellent subclutter visibility and has solid-state receiver, power supplies and controls. The receivers sensitivity (minimum discernible signal) is −115dBm with a noise figure of 4.2

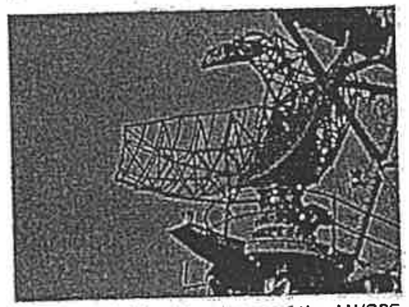


Figure 1: Lightweigt antenna of the AN/SPS-40 on Bord of Lütjens class destroyer (© 2013 www.kriegsschiffe.eu)

Specifications

frequency:	402.5 to 447.5 MHz UHF-Band
pulse repetition time (PRT):	
pulse repetition frequency (PRF):	ø 257 Hz (staggered) 300 Hz (non-staggered)
pulsewidth (τ):	60 µs (long range mode) 3 µs (short range mode) compressed to 1 µs (or 0.6 µs)
receive time:	
dead time:	
peak power:	200 – 255 kW
average power:	2 kW
instrumented range:	370 km
range resolution:	less than 0.05 NM
accuracy:	
beamwidth:	β=10.5°, ε=19°
hits per scan:	
antenna rotation:	7.5 or 15 rpm (6 rpm in SPS-40 and -40A)
MTBCF:	
MTTR:	

The antenna reflector is a truncated paraboloid reflector of open lattice work construction, covered with a wire screen to reduce weight and wind resistance. The dual feed includes the primary radar section and an integral identification friend-or-foe antenna. The primary feed is a slot type, it has a tuned cavity and flared shape to ensure proper illumination of the reflector. The reflector then forms the RF energy into a fan shaped beam with a 19° vertical beamwidth and 10.5° horizontal beamwidth. The antenna has a gain of 21 dB at a sidelobe attenuation of 27 dB in azimuth.
The AN/SPS-40 solid-state transmitter is replacing the tetrode tube transmitter of the surveillance radar, and the new version is designated AN/SPS-40E. The nominal 250 KW output of the transmitter is achieved by combining in parallel 112 power amplifier modules arranged in two groups, 56 each. The stripline approach is used in the design of the large output 56:1 combiners. When compared with their tube counterparts, the AN/SPS-40 solid state transmitters provide improved performance and superior reliability, availability, and maintainability. (The older tube version was in practice extremely sensitive to the vibrations caused by the ship's artillery.)
The solid-state transmitter architecture is highly redundant. It is predicted to have a 90 per cent probability of maintenance-free operation for 90 days with no more than 11 per cent projected reduction in radar range performance. The 112 transmitter modules are identical and interchangeable, as also are the power supplies. In the event of component failure, the system undergoes a gradual and graceful degradation in transmitter output. It remains fully operational and capable of detecting targets. The transmitter solid-state technology offers inherent tactical flexibility. For example, output power is adjustable. As a result, ships can reduce their susceptibility to detection while maintaining substantial air surveillance capability. If the tactical situation requires emission control conditions, the solid-state transmitter will respond instantly. Similarly the transmitter will immediately radiate at full power with just the touch of a push-button. Pulse-to-pulse frequency diversity is also provided. A unique automatic levelling control system greatly reduces the need for maintenance actions. This system automatically senses and compensates for degradations in transmitter module performance.
The AN/SPS-40 is operational e.g. on Bangladesh Navy's ship *Somudra Joy* (Hamilton-class). The most AN/SPS-40 radars are replaced by AN/SPS-49(V) radars in the late 1980s and early 1990s.
Versions and improvements:

- AN/SPS-40: Basic version, manufactured by Lockheed/Martin;
- AN/SPS-40A: slightly modified variant, manufactured by Sperry;
- AN/SPS-40B: including a secondary radar; a total of 43 radars were produced by Norden Systems;
- AN/SPS-40C: improved detection of low altitude flying targets, advanced EPM capabilities;
- AN/SPS-40D: modified 40A version with higher reliability, including a coupling equipment for the AN/SYS-1 system; manufactured by Westinghouse.
- AN/SPS-40E: manufactured by Norden Systems, includes the solid-state transmitter (described above)

Sources: Technical Manual, AN/SPS-40 Radar Set, NAVSEA 0967-LP-441-9010 and NAVSEA Drawing RE-D2699234

EXHIBIT B

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF PENNSYLVANIA

ROBERT J. KRAUS and
MARGARET M. KRAUS, h/w,

Plaintiffs,

vs.

No. 18-2119

ALCATEL-LUCENT, et al.,

Defendants.

VIDEOTAPED DEPOSITION OF ROGER GOSSETT

Suffolk, Virginia

Tuesday, August 20, 2019

MAGNA LEGAL SERVICES
(866) 624-6221
www.MagnaLS.com

REPORTED BY: DEBRA-LYNN BAKER, RPR, CSR

A Yeah.
Q -- what did you have to do to that wire?
And, again, I'm talking about the 390 for the moment. I'll get to some of the other stuff in a bit.
A Well, it's just a matter of determining, you know, you need a wire that's this long or that long, you cut it off, you strip the ends off of the insulation off the wire to expose the conductor and solder it back into place --
Q Okay.
A -- whether it's, you know, 2 inches long or a foot long.
Q What happened when you -- when you cut the wire, as you describe it? Did you see anything happen, or did you see anything in the air?
DEFENSE COUNSEL: Objection; form.
BY MR. PAUL:
Q You can answer the question.
A No. Well, when you cut the wire, the insulation -- you have special cutters for the wire which, you know, will cut the insulation but not the wire.
Q Yeah.
A And once you cut it, the insulation goes flying into the trash can or on the floor.
Q Did it ever fly in your face?
DEFENSE COUNSEL: Objection to form, leading.
THE WITNESS: No.
BY MR. PAUL:
Q Okay.
A You've got to be careful, you know, you don't do things like that.
Q Right. Were there any other pieces or components of the R-390 that you recall?
A Mechanical components.
Q Well, tell us about electronic.
A Yeah.
Q Okay. What's a resistor?
A A resistor is a piece of electrical equipment that's made to -- to impede the flow of electronics, and how much it impedes it depends on how it's made. You can get them that are very low resistance or very high resistance --
Q Okay.
A -- and --

Q Do you know how they're made?
A Basically, yeah. A bunch of -- first of all, the engineers determine what resistance they need. Okay? They're made in certain steps. The compounds that -- the resistive conductive compounds are chosen to provide this plus-or-minus resistance.
Q Okay.
A And then they're incorporated into a package with other stuff to keep them -- what can I say? To keep it together --
Q Okay.
A -- okay, with two wires sticking out the end.
That -- that's strictly the -- the manufacturing process. Okay? That has nothing to do with my end where I --
Q Sure.
A -- replace the resistors.
But that's -- yeah, that's --
Q Do you know any --
A -- that's basically how I -- how I know a resistor is made.
DEFENSE COUNSEL: Move to strike, lacks foundation, basis of foundation, speculation.
BY MR. PAUL:
Q Do you have any knowledge about what the compounds were made of?
A No, I haven't the slightest.
Q Now, we're talking about the 390 for the moment.
A Okay.
Q Was there a difference in resistor -- well, were resistors used in lots of other -- in other equipment?
A Yes.
Q Okay. What other pieces of equipment were the resistors used in that you recall?
DEFENSE COUNSEL: Objection. Again --
THE WITNESS: Every piece of electronic equipment on the ship has resistors in it.
BY MR. PAUL:
Q Okay.
A Whether it has -- you know, the number is -- depends on the complexity of the equipment. Some of the -- the transmitters had hundreds of resistors.

and answered.

BY MR. PAUL:

Q You can answer.

A Well, circuit boards are made in some of the equipment to plug in and, you know, circuit boards are made of fiberglass, to my knowledge, with the components mounted on them and then some sort of a clear plastic, plastic used in the generic sense, some kind of a sealer to prevent them from getting wet, getting dirty.

Q Do you recall any particular pieces of equipment that had circuit boards?

A Oh, yes.

Q Okay. Go ahead.

A Yeah. The cryptographic equipment, especially, had many circuit boards in it. That's the KWR-26 and the -- KWR-37, the KW-26, KW-7s, they were all pretty much modernized up to where they had 90 percent circuit boards.

Q Okay. And did you have -- where were these -- you did maintenance on these products?

A Yes.

Q Okay. And what part of the ship was that done in?

A Well, if you maintain a circuit

board, you pulled it out of the equipment, brought it down to the shop and troubleshot it right there in the --

Q Okay.

A -- in the shop.

Q Okay. When you opened up the equipment, what did you have to do to the equipment? And, again --

DEFENSE COUNSEL: Object to form, as overbroad.

BY MR. PAUL:

Q Again, we're -- we're talking about either the SRR-13 or the SRR-11 or the 390A or the URR --

DEFENSE COUNSEL: Same objection.

THE WITNESS: Yeah. Well, you know, depending on how the thing is made, it's -- once you get the equipment open to where you can get at the insides, there's a couple of screws or many screws that you have to take loose to get the module or the circuit board out.

BY MR. PAUL:

Q Okay.

A Pull it out, take it to the shop and fix it.

Q Did you ever have to use a vacuum cleaner?

A Yes.

Q Tell me about that. Why would you use a vacuum cleaner?

A Probably once a month, every couple of months you'd open the equipment up, vacuum it out, because dust collected in there, and it was part of our -- let me see. The name of the system was POMSEE. I don't, exactly, know what that stands for, but it was a preventative maintenance shipboard electronic where you cleaned the place out and made sure that everything was pretty and put it back together so that the dust did not accumulate.

Q Now, when you say once a month, you're talking about -- are you talking about once a month in the shop or once a month for each piece of equipment?

A Once a month --

DEFENSE COUNSEL: Objection; misstates his testimony.

THE WITNESS: Once a month for each piece of equipment. You know, you had a regular schedule --

BY MR. PAUL:

Q Okay.

A -- that -- you know, and -- and you had a little book, you had to sign it saying, yeah, yeah, we did it.

And you open it up, clean it out, clean the air filters, if so --

Q Okay.

A You know, if it had an air filter in it, and basically make sure it was lubricated and cleaned, put it back together. As long as it was working, leave it.

DEFENSE COUNSEL: Move to strike nonresponsive portions.

BY MR. PAUL:

Q During the time you were on the Cambria, how many pieces of equipment were maintained or repaired using the vacuum cleaner system that you have described in the shop itself?

DEFENSE COUNSEL: Object to form, calls for speculation, misstates the witness's testimony.

DEFENSE COUNSEL: Lacks time and scope.

THE WITNESS: I can't really say. In the shop, I would say very little use of the vacuum cleaner in the shop, because we normally take it to the equipment, open the equipment up, vacuum it, clean it, whatever, and lubricate it, put it back together.

BY MR. PAUL:

Q You say -- you are talking about not in the shop but someplace else on the ship?

A That is correct.

Q Okay. All right. You mentioned the UR -- WRT-1 and the --

A Yes.

Q -- TED.

Tell me about those pieces of equipment.

A Well, WRT-1 is a transmitter, a low-frequency transmitter, which every ship, major ship, has one. It's basically the same size as the SRT, a little bit larger, again, specifically designed to transmit in low-frequency range as opposed to the high-frequency range.

It's a lot of tubes, slide-out drawers. You know, it's a pretty complex piece

of engineering, and it worked pretty good. Every once in a while, you know, a tube would go bad or something like that, but a pretty good piece of equipment really.

Q Okay. All right. I am going to -- sir, I am going to ask you to look at what has previously been marked as Plaintiffs' 12 and Plaintiffs' 14.

And let's go off the video while he goes through those.

THE VIDEOGRAPHER: Go off record at 9:51 a.m.

(Discussion off the record.)

(Plaintiffs' Exhibit 14 was marked for identification by the court reporter.)

THE VIDEOGRAPHER: We are back on record at 9:52 a.m.

BY MR. PAUL:

Q Okay. Sir, what -- what are you seeing in these pictures?

A This is an SRR-13 receiver.

Q Okay.

A And pretty much the way it's mounted on a ship in its own individual cabinet.

Q Why don't you hold that up to the -- to the jury can see it and point to it, what you're talking about.

Is that the top --

A Yeah, here.

Q -- one?

Okay. That's what it looks like?

A Yeah, basically.

Q All right.

A This thing is bolted or -- or, you know, in a -- on a table or a mounting of some kind. The picture here shows you how to get it out of the cabinet.

Q Okay.

A Just pick the handles up and hold them up and slide it out. Once you --

Q What would happen -- let's start -- what would happen when you would pull out the -- pull the piece out like that? What would happen, if anything?

A It comes out to -- to the end of the stop. It won't go any farther.

Q Okay.

A I mean, you know, you can leave it hang there, if you so desire.

Q Okay.

A But it -- it will tilt up and down so you can look at the top and the bottom, or you can push the buttons on the rail and take the whole thing out and take it to the shop and work on it if -- you know, if it's necessary.

Q Now, the bottom picture, that's when it's actually -- the whole thing is removed?

A Yeah. That -- that's how to take it --

Q Why don't you show that to the --

A -- off of the --

Q Show that to --

A -- off of the sliding rails.

Q Show that on the video, too, if you would.

A Yeah, right here.

Q Now, you mentioned dust before. Was there dust when you removed this, when you did this job?

A Well, normally this type of receiver, because it's built specifically for shipboard use, is fairly airtight. There has to be some circulation to let the heat get out, but normally the thing is cooled off with an internal fan and

an air filter.

One of the purposes of removing this thing, like it's shown here, is to get at the air filter and make sure it's clean air back in the back of the equipment or, you know, anything that's accumulated.

Q Okay. And, in fact, there was -- you personally recall seeing dust accumulated when these were removed?

DEFENSE COUNSEL: Object to form, leading.

BY MR. PAUL:

Q If I've -- if I'm stating correctly -- tell me if I'm stating correctly what you --

A Yes.

Q -- just said.

A There -- there were occasions when there were dust inside the equipment.

Q Okay.

A Yeah.

Q Now, was this unique to the SRR-13, or was that true generally?

DEFENSE COUNSEL: Object to form.

THE WITNESS: No, that's pretty much

generally every piece of equipment. The -- the amount of dust, dirt, crud, whatever you want to call it, that accumulated depended on the design of the equipment, how much air could actually get in from outside.

And like I said, normally these things are designed to prevent dust from getting in, but you can't make them totally dust-proof.

BY MR. PAUL:

Q Okay. Are these -- is this -- are most of these transmitters and receivers high temperature?

DEFENSE COUNSEL: Object to form; calls for speculation, vague.

THE WITNESS: In my opinion, yeah, you've got to watch out. Especially the tubes --

BY MR. PAUL:

Q Okay.

A -- you know, tubes are -- don't grab them until they cool down.

Q And each of these had -- the SRRs and some of these other pieces of equipment you have talked about --

A Yeah.

Q -- all had tubes in them?

A Yeah.

Q Okay. And they were hot to the touch, you say?

A Yes.

DEFENSE COUNSEL: Objection; leading.

(Plaintiffs' Exhibit 13 was marked for identification by the court reporter.)

BY MR. PAUL:

Q Okay. Turn to what's marked on the bottom as LMCKR 39. Do you see that one? It says "Section 4" on the top. "Section 4" on the top.

A 39? Oh, okay. Let me see here. 31 -- okay. Oh, 39. Okay.

Q Do you see it?

A Yeah.

Q Okay. What do we see here?

A Okay. This looks like removing parts from the internal of a receiver. On this upper picture, you can see the mechanical couplings here where the --

Q Can you hold it --

A -- outside dials and so forth --

Q Hold it this so way so the camera can

see it. Go ahead.

A This here?

Q Yeah.

A Okay. Once you get the -- the thing mechanically decoupled, you -- you can pull it out or, as shown in the bottom picture, you can take out a plug-in board.

Q Okay.

A Yeah. This one, the plug-in board there shows resistors, capacitors, whatever you want to call them, and the connecting pins so that they will hook into the -- the main chassis.

Q Can you show me or tell the jury which is the resistors and which are the capacitors in this picture, if you can see them?

A Yeah. Okay. On -- right here, this little darkish thing with the stripes on it, okay, is a resistor.

Q Okay.

A Okay? The stripes indicate the -- the particular resistance of the resistor.

Q Okay.

A The size of it indicates whether it's a half a watt, 1-watt, 2-watt, whatever.

Q Okay.

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shop where we could -- had the room and the tools --
Q Okay.
A -- to take it apart and do what we had to.
Q Okay. Did you ever work on the antennas?
A Yes.
DEFENSE COUNSEL: Object to form.
BY MR. PAUL:
Q Tell me about that.
A Well, the antennas were -- most of them were -- were pretty good. There was hardly any work that needed to be done, as far as repair.
The main thing that had to be done on the antennas was the transmitting and receiving antennas had a big insulator on the bottom, which accumulated saltwater -- or salt spray, I should say, and dust and dirt, whatever, and every once in a while they had to be cleaned off just to maintain proper operation.
Q Do you recall how often you had to clean them off? And, again, I am confining, you know, to your time on the Cambria.

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A Yeah. I think about every three months. I'm not sure of -- of the exact schedule, but roughly every three months --
Q Okay.
A -- they had to be cleaned.
Q Do you remember any numbering or nomenclature to describe the antennas?
A Most of the antenn- -- we had two kinds of antennas for the communications, what we call a 35-foot whip, which was an aluminum 35-foot long antenna which came in four sections, I believe, and mounted on this large antenna insulation that I mentioned, then we also had wire antennas.
Q I'm sorry, wiring?
A Long wire antennas.
Q Oh, wire antennas?
A A big --
Q Okay.
A -- copper, bronze cable that we ran between one mast and the other and then down to an end insulator where the transmitter fed into it.
Q Do you remember any numbering for these transmitters? For these antennas, I should

Page 96

say.
A No. The 35-foot whip, I know it was AS dash something or another, but I don't remember exactly what it was.
Q Okay.
A The long wire antennas, it was however piece of long wire you needed. There was no number.
Q What does the term -- do you know what the word "SPS-40" means?
A SPS-40, yes. That's a --
Q What's that?
A -- radar system, air search radar.
Q Okay. And that's different from what I'm talking about with antennas?
A Yeah. Well, the SPS-40 antenna itself is -- it's unique to the radar. It's a rotating antenna which mounts up as high as we can get it, and it's fed by a wave guide from the -- not a wave guide, but a -- okay. We called it a wave guide, but it was actually a coax, hard coax.
Q Okay.
A And the antenna maintenance itself, it never needed anything done.

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Q Okay.
A I mean, you know, the -- the rain cleaned it off. We -- as long as the motor made it go around and the connections were made between the antenna and down below, it didn't do anything.
Q Were there pieces of the SPS-40 that had to be maintained or worked on?
A Yes.
Q Let me show you what's been previously marked as 6.
(Plaintiffs' Exhibit 6 was marked for identification by the court reporter.)
THE WITNESS: Okay.
BY MR. PAUL:
Q Is that what we're talking about, the SPS-40?
A Yes. That's the SPS-40 antenna. Yes.
Q Okay. All right. The second page of that document, what is that document to you?
A Okay. This is a system diagram of the entire SPS-40 system, transmitters, receivers, antennas, everything, all the

electronics that are needed to make the whole thing work.

Q Okay. What parts of the SPS-40 did you and the men working for you have to work on?

A Okay.

DEFENSE COUNSEL: Assumes facts not in evidence, misstates testimony.

THE WITNESS: In the --

BY MR. PAUL:

Q And if you are able to, hold it up to the --

A Oh.

Q -- to the picture --

A Sorry.

Q -- and show that to the jury.

Go ahead.

A Okay. The antenna up here is the one that I said, you know, pretty much it's -- unless something broke --

Q Okay.

A -- we hardly ever had to work on it.

Q Okay.

A But the -- the controls -- the electronics, it's rather complex.

Q ~~Why is it complex?~~ When you say

complex, why do you mean that?

A Well, it's -- it's a lot of pieces of equipment here.

Q Okay.

A After I left the Cambria, later on in my career I had an opportunity to serve as an instructor for the SPS-40 alpha radar system at Naval Training Center --

Q Okay.

A -- Norfolk.

Okay? So I'm quite familiar with how complex it is.

Q Okay.

A Okay?

Q Tell me what kind of work had to be done on this, on this SPS-40.

DEFENSE COUNSEL: Object to form.

THE WITNESS: Well, again, it's -- it's pretty much the type of thing which -- which works as long as it works.

There was one guy, Stubblefield, Dave Stubblefield --

BY MR. PAUL:

Q Right.

A -- was the technician who had gone to

school on this, and he pretty much knew how things worked.

Okay? And whenever anything went wrong with the -- with the 40, Stubblefield was the guy you called.

Q Did -- we have talked about a number of different pieces of equipment. We talked about receivers, transmitters --

A Yeah.

Q -- transceivers, resistors --

A Right.

Q -- capacitors --

A Yeah.

Q -- wire and cable.

We talked about a lot of products so far.

A Yes.

Q Which, if any of those products, was on this SPS-40 system?

A All of them.

Q Okay.

A I mean, you know, it's a real complex system. Okay?

Q Stubblefield was the one that primarily worked on that?

A Yes.

Q Okay. Did you ever see Stubblefield and Kraus together when Stubblefield was working on the SPS-40?

A No, I did not, but that was because the SPS-40 in -- in the radar room, everything was, you know, pretty much filled up. They -- they didn't allow for a whole lot of room.

Q Okay.

A And if Dave Stubblefield was in there working and Mr. Kraus was in there with him, there's no more room.

Q Okay. Was it part of Kraus's job to monitor what Stubblefield was doing?

A Yes, yes. He was part of the -- the electronics gang.

Q Okay.

A He was the radar -- part of the radar section.

Q Stubblefield was?

A Stubblefield.

Q You say "He." I'm just trying to --

A Yeah. He, Stubblefield, was -- was part of the radar section. Yeah. Mr. Kraus was in charge of the radar section and the COMM

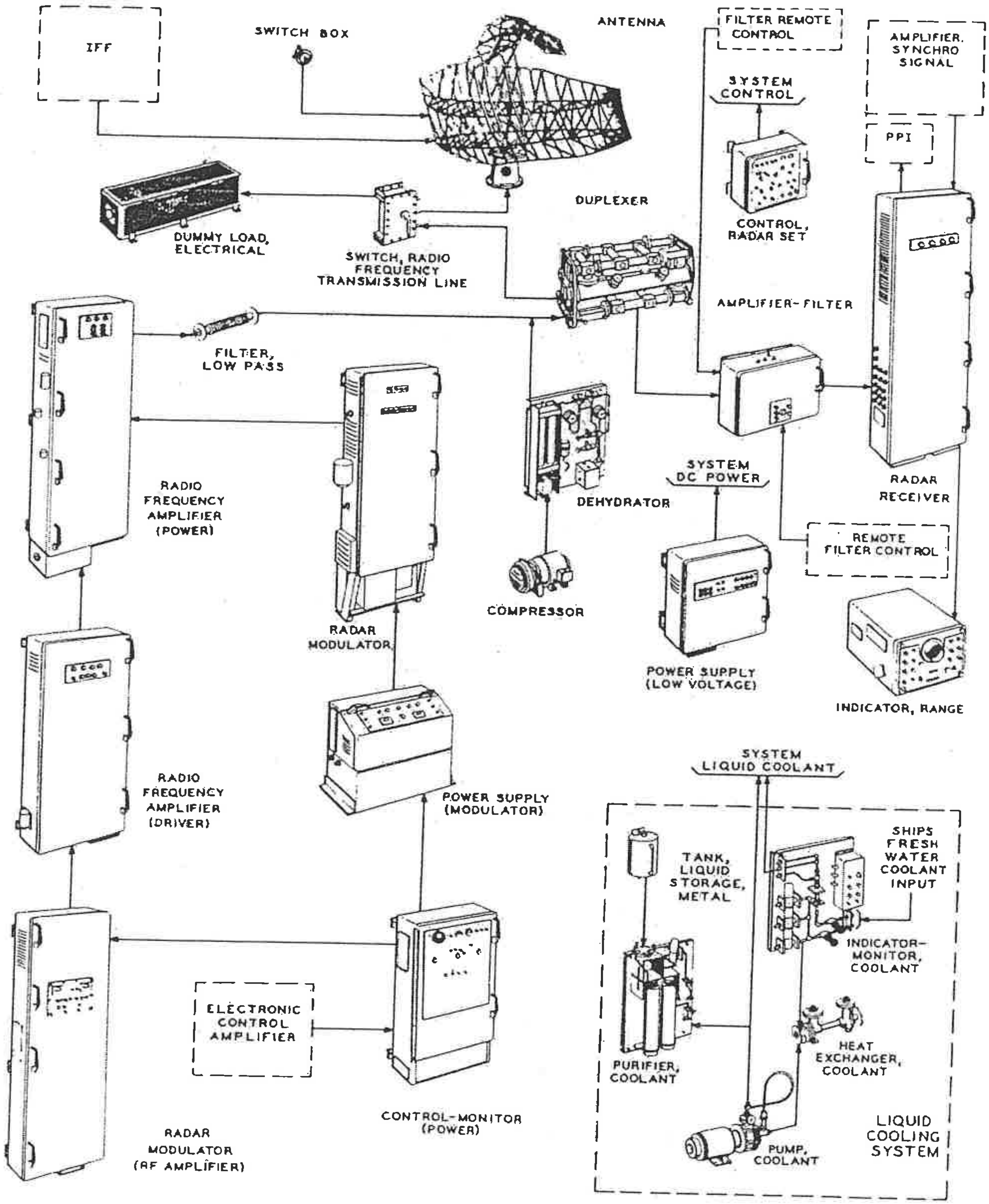
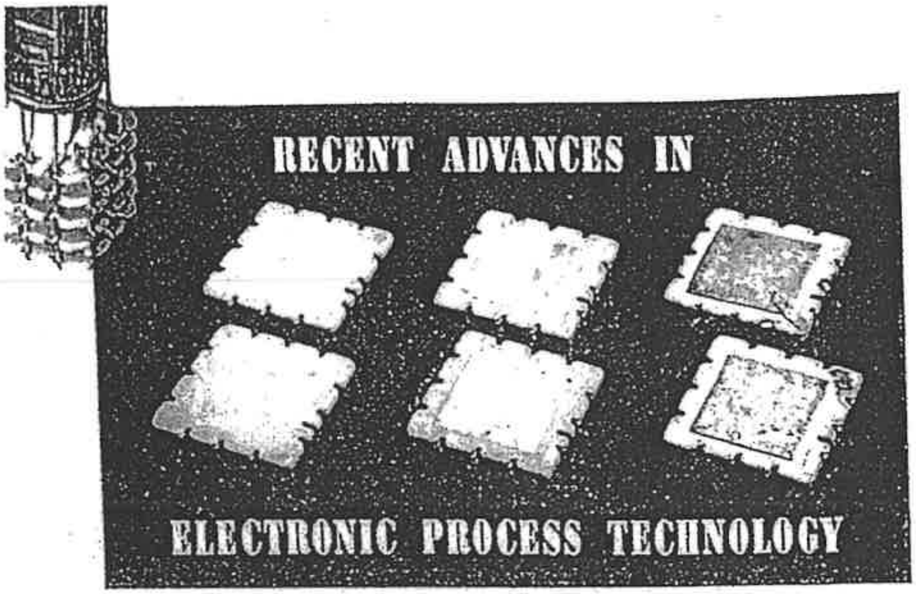


Figure 6-4.—Air-search Radar Set AN/SPS-40 system. 120.83

EXHIBIT C



RECENT ADVANCES IN ELECTRONIC PROCESS TECHNOLOGY

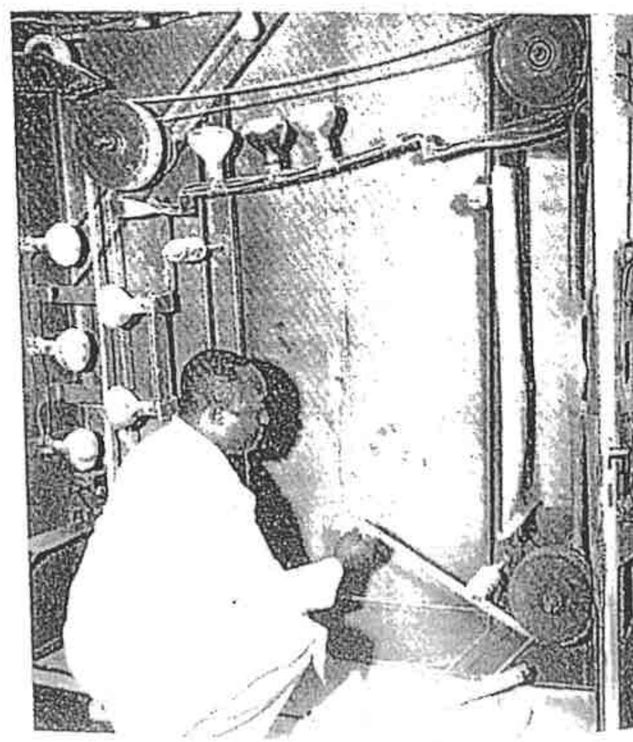
MDE–MPE tape capacitors in stages of production. Wafers at left are cured steatite blanks of same general type used in MDE–MPE system. Silver pattern that forms one electrode of capacitor has been applied to two wafers in the center. In wafers at right, adhesive dielectric-coated tape is cut into squares slightly larger than the silver contact and then pressed down onto the wafers. After curing, the capacitor is ready to be assembled into a module with other wafers such as that shown at top left.

SINCE the announcement of a new system for the mechanized production of electronics in 1953, the National Bureau of Standards has developed additional compatible components and techniques under the sponsorship of the Navy Bureau of Aeronautics. Recent advances achieved by NBS in electronic process technology include an adhesive tape capacitor, a "chip" resistor, and a method for applying pyrolytic carbon resistors. Developed by B. L. Davis of the Bureau's process technology laboratory, these components and techniques should do much to increase the versatility and applicability of electronic equipment manufactured by automatic production lines.

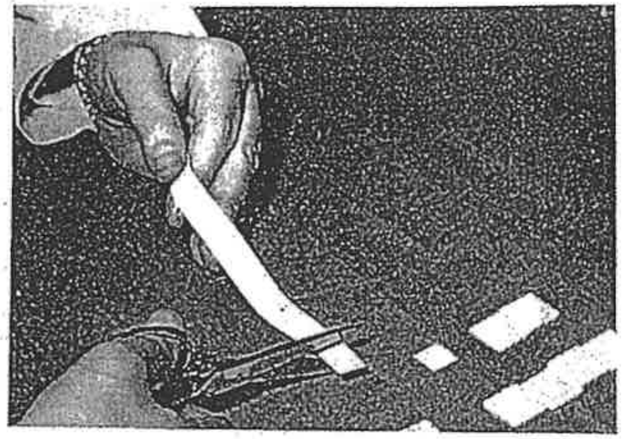
The development of systems for Modular Design of Electronics and Mechanized Production of Electronics (MDE–MPE), formerly code-named Project Tinkertoy, was begun by the Bureau with the cooperation of several industrial companies under the sponsorship of the Navy Bureau of Aeronautics as an industrial preparedness measure. The MDE–MPE system starts with raw or semiprocessed materials and automatically manufactures ceramic base wafers, dielectric elements for capacitors and adhesive tape resistors; prints conducting circuits and capacitors; and mounts resistors, capacitors and other component parts on standard, uniform steatite wafers. The wafers are stacked like building blocks to form modules that perform all the functions of one or more electronic stages. The pilot plant, operated by a commercial contractor, incorporates the principles of this system. The plant was designed to produce 1,000 finished and inspected modules per hour.

The Tape Capacitor

The self-adhesive tape capacitor is designed specifically for application to the ceramic wafer by MDE–MPE machine techniques. It is manufactured in much the same manner as the NBS adhesive-tape resistor.[1] A conducting tape, coated on one side with a dielectric, provides one element of the capacitor. The other element is a silver pattern printed and fired on the wafer. It is now possible to apply an adhesive-tape



In this chamber electrically conducting solution is sprayed on one side of tape, dried, and then sprayed on other side. When cured, dielectric formulation is sprayed on one side of tape. It is then ready to be used as one element of the capacitor. Spray unit can be seen at far right.



Application of adhesive tape capacitor to wafer. Although shown here as a manual operation for demonstration purposes, it is normally applied by machine.

resistor to one side of a wafer and an adhesive-tape capacitor to the other side.

The materials required for the manufacture of tape capacitors are a heat-resisting asbestos paper tape, silver flake, silicone resin, butyl cellosolve, a powdered high-K titanate body, *n*-hexane, and epoxide resin. The electrically-conducting formulation (a mixture of the silver flake, silicone resin, and solvent) is ground in a ball mill. The mixture is sprayed on a loop of tape 1¼ in. wide, allowed to dry thoroughly, and then sprayed on the other side. When cured, the metallized tape is conductive along each side and from one side to the other. After slitting along the center to form two ⅝-in tapes, it is ready for application to the dielectric film. A roll of tape 19 ft long will produce about 350 capacitors.

Second element of capacitor is a silver pattern printed on an MDE-MPE wafer. Elements may be printed on either or both sides, depending on requirements of finished circuit. An adhesive tape resistor can be applied to opposite side of wafer instead of a capacitor, if desired.

The dielectric formulation is composed of high-K titanate body that has been pulverized in a ball mill with *n*-hexane until the particle size is about 1 to 2 microns, after which the slurry is allowed to evaporate under a hood. The ground titanate body is mixed with epoxide resin and further ball-milled. This tacky dielectric mixture is then sprayed on the metallized base tape in various thicknesses determined by the number of passes the tape makes in front of the spray gun. Thicker applications, of course, make capacitors of lower value.

The silver pattern that forms one electrode of the capacitor is applied to the steatite wafer by means of a screen press. It is then dried and fired onto the ceramic. The adhesive dielectric-coated tape that forms the other electrode is cut into squares slightly larger than the silver contact and pressed down on it. A narrow conductive strip, similar to resistor tape but with a conductivity of approximately 0.02 ohm per half inch, is laid down between a contact on the edge of the wafer and the top side of the capacitor. The complete assembly is then cured by placing it in a oven at room temperature, raising it to 225° C over period of one-half hour, and holding the temperatur at 225° C for 45 minutes.

Capacitors of higher values can be manufacture by applying a number of layers of tape, one on to of another, with appropriate connections to the edg of the wafer. Smaller capacitors can be made by reducing the area of the silver pattern printed on the wafer, or by increasing the thickness of the dielectric layer. For typical values, see table 1.

Shelf life tests indicate that the capacitance changes no more than 1 percent during the first month after manufacture, and that there is no change in the dissipation factor, which averages 0.7 percent at 1 kc. However, the capacitance does change somewhat with temperature, −3 percent from 25° to 85° C, and −15 percent from 25° to −55° C. In a load life test, a few capacitors shorted out, but otherwise only negligible changes occurred in capacitance and dissipation factor.

The "Chip" Resistor

The "chip" resistor is made by applying self-adhesive resistor tape to a small chip of ceramic material. This resistor is not for use in the regular quantity production of modules, but aids the electronic design engineer in studying new modular circuits which are still in the "breadboard" stage or in producing prototype equipments for evaluation. The chip is inserted into a circuit simply by soldering it to the appropriate connections on a standard wafer.

The precured resistor tape is manufactured automatically by the usual MDE–MPE techniques but is applied to a chip of cured steatite about 0.600 by 0.225 in. instead of the standard MDE–MPE wafer. A prototype machine developed in the NBS laboratories

of a highly accurate gas thermometer for this purpose requires painstaking and time-consuming precision, the work on the secondary thermometer is being pursued concurrently. Resistance thermometers constructed of the semiconducting elements, silicon and germanium, have proved to be extremely sensitive; in some cases the resistance changes more than 50 percent per degree. While satisfactory reproducibility still remains a problem, results of initial tests have been quite promising.

References

[1] New International Temperature Scale, NBS Technical News Bulletin **33**, 28 (1949).

[2] H. F. Stimson, The International Temperature Scale of 1948, J. Research NBS **42**, 211 (1949) RP1962.

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[6] J. B. Garrison and A. W. Lawson, Absolute noise thermometer for high temperatures and high pressures, Rev. Sci. Inst. **20**, 785 (1949).

[7] Robert J. Corruccini, Annealing of platinum for thermometry, J. Research NBS **47**, 94 (1951) RP2232.

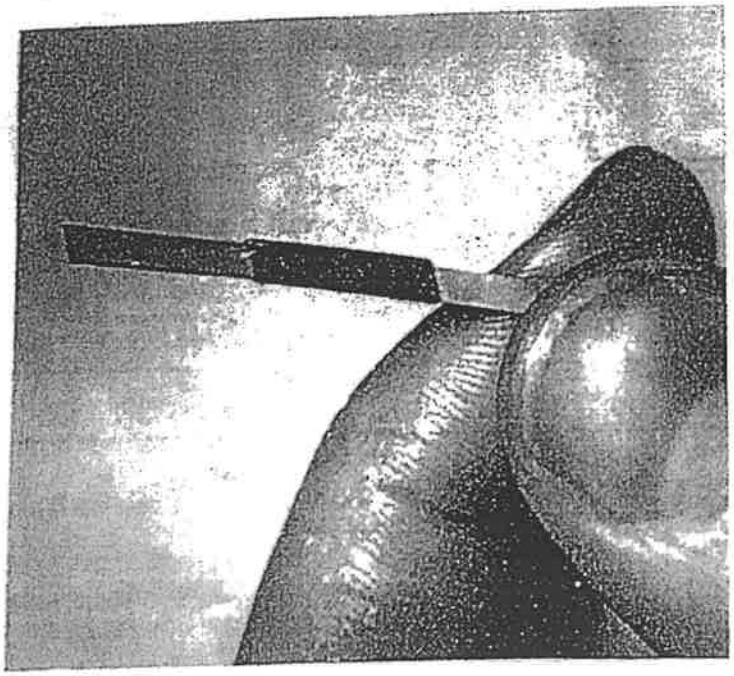
[8] Lawrence C. Liberatore and Raymond E. Wilson, Aging changes in clinical thermometers, J. Am. Ceramics Soc. (In press).

NBS Precured Tape Resistor

THE ADHESIVE-TAPE resistor developed by the Bureau has aroused wide interest since its announcement in 1951.[1] In the NBS tape-resistor system, designed primarily for electronic printed-circuit applications, small pieces of self-adhesive resistance-coated tape are simply pressed into place against metallic terminals at the proper points in the circuit. The resistor was developed as part of a program of miniaturization of airborne equipment sponsored by the Navy Bureau of Aeronautics. Despite its advantages, the method has been limited in some applications by the necessity for baking the supporting base material to cure the resistors after they have been pressed in place.

A new precured wire-lead version of the tape resistor, now being made at NBS, obviates the need for heat-curing after placement in the circuit. The new resistors are made by pressing uncured resistor tape against both sides of suitable wire or metal-ribbon leads; the leads are thus sandwiched between two pieces of resistor tape. These units are then given the usual heat cure, which bonds the resistor tape to the

[1] A high-temperature adhesive tape resistor, *NBS Tech. News Bull.* 35, 100 (July 1951). *Described in detail in* An adhesive tape resistor system, *NBS Circular 530, Government Printing Office, 30¢.*



Left: the recently developed precured version of the Bureau's tape resistor can be soldered or spot-welded into the circuit. The original version of the NBS tape resistor is self-adhesive, but must be heat-cured by baking the chassis after all resistors have been pressed in place. The precured resistor is made by sandwiching suitable metal leads between two uncured resistors and then heat-curing, which bonds the resistor to the leads. Over-all length is about 1½ inches. *Right:* soldering one of the precured NBS tape resistors into place. Because no subsequent heat-curing is needed, this version of the tape resistor can be used with chassis that would not withstand curing temperatures (about 300° C.).

leads and results in resistors that may be soldered or spot-welded into the circuit.

With the new precured variation in addition to the basic press-on form, the range of possible applications of the NBS tape resistor is greatly extended. Characteristic advantages of the NBS tape resistor—compactness, stability, and high-temperature operation—are largely retained in the precured wire-lead design. Furthermore, the new resistor might well prove more economical to manufacture in quantity than other types having less desirable characteristics.

The basic NBS tape resistor is made by coating asbestos-paper tape with a mixture of carbon black or graphite, silicone resin, and solvent. Resistor dimensions are standardized at one-half inch long and about one-eighth inch wide; a variety of coating formulations have been developed to give a wide range of resistor values.

Leads for the precured tape resistor are now being made from ribbon of thin silver or silver-plated copper at NBS. Leads extending one-half inch beyond the resistor proper are used, bringing the over-all length to 1½ inches. Thickness is held to about 0.012 to 0.015 inch.

Preliminary tests indicate that the precured NBS tape resistor, when supported in air by its leads alone, will not provide the full dissipation of 0.25 watt at 200° C for which the basic resistor was designed. Further test work is now in progress, and a suitable derating curve will be worked out.

New NBS Director Appointed

DR. ALLEN V. ASTIN has been appointed* Director of the National Bureau of Standards. Formerly Associate Director of the Bureau, Dr. Astin has been Acting Director since October 1951. Dr. Astin has also been appointed a member of the National Advisory Committee for Aeronautics.

Dr. Astin has been a member of the Bureau's staff since 1932. Until 1940 he was principally concerned with dielectrics and electronics. His contributions include development of improved methods for precise measurement of dielectric constants and power factors of dielectric materials and studies of the nature of energy losses in air capacitors. He did pioneering work in the development of radio telemetering techniques and instruments and applied this work to studies of cosmic rays and of meteorological problems in the earth's upper atmosphere.

In 1940 Dr. Astin was one of the Bureau scientists doing pioneering work in proximity fuze research and development for bombs and rockets. He became chief of the Optical Fuze Section in 1943, assistant chief of the Ordnance Development Division in November 1943, and chief of the Division in July 1948. He played a major part in the development and evaluation of bar-type proximity bomb fuzes and in their introduction to service during the war. During the fall and winter of 1944–45 he served in Europe as representative of the Bureau and consultant for the Ordnance Accessories Division of the National Defense Research Committee, concentrating on proximity fuze problems. He edited the terminal three-volume Technical Report of the Ordnance Accessories Division (Division 4).

As chief of the Ordnance Division from 1948 to 1950, he supervised the Ordnance Laboratory, the Guided Missile Laboratories, and the Electronics and Tube Laboratories. When Dr. Astin was appointed Associate Director in May 1950, he assumed responsibility for the work of the Ordnance Development, Missile Development, Electricity, and Electronics Divisions as well as the Office of Basic Instrumentation.

Dr. Astin was born in Salt Lake City, Utah, on June 12, 1904. He received the B. S. degree in physics from the University of Utah in 1925. While working toward his advanced degrees at New York University from 1925 to 1928, he was a graduate assistant and instructor in physics. From N. Y. U. he obtained the M. S. and Ph.D. degrees in physics in 1926 and 1928 respectively. From 1928 to 1930 he held a National Research Council Fellowship at Johns Hopkins University, doing basic research on measurement techniques relating to dielectric materials. Between 1930 and 1932, he was a Research Associate in a program sponsored at the Bureau by the National Research Council and the Utilities Research Commission, Inc.

Honors and awards he has received include the following: National Research Council Fellow in Physics, 1928–1930; Navy Ordnance Award for Exceptional

Dr. Allen V. Astin

Patented Aug. 6, 1935

2,010,133

UNITED STATES PATENT OFFICE

2,010,133

RESISTOR

Sidney Bloomenthal, Merchantville, N. J., assignor to Radio Corporation of America, a corporation of Delaware

No Drawing. Application November 25, 1933, Serial No. 699,707

16 Claims. (Cl. 201—76)

My invention relates to resistors and more particularly to resistors of types suitable for use in radio receivers, wherein noise occasioned by variations in resistance during the passage of current therethrough must be minimum.

Resistors of types used in radio receivers must be "quiet". That is to say, since such resistors are usually utilized in connection with sensitive thermionic devices, their resistance must not fluctuate while they are conducting electric currents. This requirement must be met to a greater or less degree in the manufacture of all resistors of the types under discussion.

A resistor for use in radio receivers should also have a substantially zero temperature coefficient of resistance and a low load-coefficient of resistivity. That is to say, it should be so made that temperature changes occasioned either by atmospheric conditions or by the passage of electric current therethrough will not materially affect the resistance value.

It is, accordingly, an object of my invention to provide a new and improved resistor that shall be substantially free from noise when used in an amplifier.

Another object of my invention is to provide a resistor that shall have a substantially zero temperature coefficient of resistance during normal operation thereof.

Another object of my invention is to provide a resistor that shall have a low load-coefficient of resistivity.

It is also highly desirable that manufacturing methods be devised and materials provided whereby quantity production of resistors having accurately predetermined values may be had. It is, accordingly, a further object of my invention to provide such methods and such material.

A still further object of my invention is to provide a new resistor material capable of being molded into any desired shape with full assurance that the resulting device will have the predetermined resistance and temperature coefficient characteristics.

The foregoing objects and other objects ancillary thereto I prefer to accomplish, in short, by first coating particles of a filler material, such as asbestos, powdered glass, sand, or the like, or a mixture of filler materials, with a polymerizable resin in solution and thereafter causing conducting material, preferably graphite and/or carbon black, to be precipitated upon the coated particles from a colloidal solution thereof.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment.

Substantially all fixed resistors used in radio receivers, amplifiers, and the like, include a filler, a conducting material, a binder, and a moisture-repellent impregnating material. The electrical and mechanical properties of the resistor depend not only upon the nature of these components but on the manner in which they are put together.

Previous to my present invention, I made many experiments in the effort to utilize asbestos, glass, or sand singly as well as various mixtures of sand or glass and asbestos, as fillers. For a binding material, I tried many grades of phenol formaldehyde resin in liquid and powdered form or in the form of varnish. For the conducting material, I tried dry graphite and carbon black, but in all of my early experiments I found that, if the conducting material was first mixed with the filler and the binder thereafter added, the resistors made from such a compound were extremely variable in resistance value and could not accurately be reproduced by factory processes.

According to my invention, therefore, I first take a predetermined amount of finely ground glass and air floated asbestos and intimately mix with it a solution of phenol formaldehyde resin (known as bakelite) in acetone. The principal function of the ground glass is to impart to the finished resistor a rough surface to which paint and sprayed metallic terminals will firmly adhere. For the mixing process, I prefer to use a device commercially known as a "kneader" and continue the kneading process until substantially all of the solution is evaporated. At this stage in the process, the mass of material has a dough-like consistency and if a small portion of it is examined under a microscope, it will be apparent that every particle of the asbestos and glass is covered with a film of unpolymerized resin left by the evaporation of the acetone.

The "mix" is next removed from the kneader and is crumbled into particles which are allowed to stand until all of the solution evaporates and it becomes quite hard and brittle. The material is next placed in a ball mill, or grinder of any convenient type, and is ground until substantially all of it becomes fine enough to pass an 80 mesh screen.

While the process of grinding is being carried

on, the conducting material may well be in course of preparation. For this material, I prefer to use a colloidal suspension of carbon in water, such as the graphitic material known to the trade as "Aquadag", manufactured by the Acheson Graphite Company, a gas-carbon suspension known as "Aquablack", manufactured by Binney & Smith Company, or a suitable mixture of the two.

In view of the fact that graphite has approximately one-tenth the resistance of carbon, such as is utilized in the manufacture of aquablack, these two commercial materials cannot be interchangeably utilized in the same proportions. It is, however, desirable to use aquadag for resistor elements having relatively low resistance and aquablack or mixtures of the two suspensions, suitably diluted, for resistors having relatively high resistance.

For resistors having high resistance values, it is particularly desirable to use mixtures of graphite and carbon black made from natural gas. If graphite alone is used for such resistors, the proportion thereof is so small that the particles are quite widely separated. This condition gives rise to noise which is obviated by the presence of carbon black particles that effectively "bridge" the graphite particles.

The 80-mesh resin coated particles are next intimately mixed with the colloidal carbon suspension, which has been diluted with water to a point whereat the liquid is substantially 1% carbon by weight, by a stirring operation and, for this purpose, mixing apparatus of substantially any well known commercial type may be utilized.

For the purpose of explanation of the foregoing paragraph, it is to be understood that the term "colloidal carbon suspension" is intended to include diluted aquadag, diluted aquablack, or a diluted mixture of the two. It is also within the scope of my invention to first mix the resin coated particles with either one or the other of the first-mentioned solutions, and to thereafter mix or add the other solution, thus causing successive precipitation of carbon in different forms on the particles.

Under usual conditions of manufacture, the introduction of the resin-coated filler material into the colloidal carbon suspension disturbs the electric charge relations existing in the said suspension, with the result that the carbon is precipitated onto the filler material and forms a conductive film over the entire surface of each minute particle thereof. Under certain conditions the colloidal suspension of the carbon persists and, in such case, I find it advisable to add to the mixture a small amount of hydrochloric acid which coagulates it and causes the precipitation hereinbefore mentioned. As an alternative, for the purpose of coagulating the colloidal suspension, I may add to the acetone solution of the resin, before coating the filler particles therewith, a small amount of furfural or of some other volatile material such as acetic acid, having an ionizable hydrogen atom with which it readily parts. For this purpose, I have also obtained fairly good results with small quantities of an organic acid such as malic, citric, tartaric, or the like.

After the carbon is precipitated onto the filler material particles, the supernatant liquid is either drained off or the solution is filtered in a filter press or the like. The cake resulting from the filtering process is dried at a temperature of approximately 40° C., for 24 hours, or, at least, for a period of time sufficient to drive off substantially all of the residual moisture.

In order that the continuity of the carbon film on the filler particles shall not be interrupted, the dried cake must be handled rather carefully. In other words, it is highly inadvisable to subject the cake to any further grinding operations to prepare it for handling, and at this point in the process it is found best to manually crumble the cake into small particles suitable for charging a molding machine.

The crumbled material is next loaded into the hopper of an automatic "pill" making machine, such as is used in the drug industry, or into equivalent well-known apparatus, which forms it into cylindrical rods under a pressure of the order of ten tons per square inch. For the sake of uniformity, I prefer to form rods ¾" in length and ¼" in diameter if the power rating thereof is not to be in excess of one watt. The rods made as described are then placed in trays and baked in an oven at 170° C. for approximately one hour.

I am not, at this time, prepared to exactly explain all of the physical changes caused in the pill by the baking process and consequent polymerization of the resin coating underlying the carbon on each particle of filler.

It appears, however, that during the baking step of the process, the carbon films on the particles merge together to provide what might be termed a "honeycomb" structure, of conducting material, and that the polymerization of the binder serves to lock the elements of the said honeycomb structure firmly in place, without disturbing the continuity of the carbon contacts. However, in view of the fact that the carbon films are extremely thin, it is, of course, probable that some of the resin may seep through them and bond with resin from other particles. As a matter of fact, the binder does not appear to have any pronounced insulating action and it may well happen that the theory first above given is correct.

In order that my disclosure shall be complete, the following specific directions for making 1000 resistors, each having a resistance of 700 ohms and each capable of dissipating one watt, are given:

For the above purpose, I take 5 lbs. of glass ground to pass a 150 mesh screen, 2¼ lbs. of air-floated asbestos, and mix them in a kneader with 1.62 lbs. of phenol-formaldehyde resin dissolved in 8 lbs. of acetone.

To coat the amount of filler material specified, in order to obtain the desired resistance characteristic, requires .126 lbs. of graphite. This weight of graphite is contained in .63 lbs. of commercial aquadag which is diluted by adding to it approximately 5½ pints of distilled water to form a colloidal suspension having the required density.

The following table gives relative proportions of filler, resin, and carbon for a number of finished resistors ¾" long and ¼" in diameter:

Asbestos	Resin	Graphite	Carbon black	Glass	Resistance
Percent	Percent	Percent	Percent	Percent	
72	25	3	----------	----------	700 ohms.
73	25	2	----------	----------	2000 ohms.
74	24.5	1.5	----------	----------	500000 ohms.
24	18	.7	2.3	55	1.2 megohm.
24	18	1.2	2.3	54	17000 ohms.
24	18	1.4	2.3	54	11000 ohms.

From the foregoing table, it will be apparent

that a resistor having any desired resistance characteristics may be made by suitably choosing the relative amounts of filler and conducting material. It will also be noted from the table that the variation in the resin content plays a very minor part in the resistance of the finished article, which is in accordance with the theory hereinbefore advanced.

After baking, the resistor rods must, of course, be provided with suitable terminals. For this purpose, I find it best to utilize the Schoop metal spraying process and I apply to each end of the resistor a ring of copper or tin extending inwardly from the end a distance of $\frac{1}{16}$''. Obviously, the resistance of the rod measured from end to end can be further controlled at this point in the process by adjusting the width of the sprayed terminals. As a general rule, however, this is not done in the factory, for the reason that it is much more convenient to so arrange the spraying machinery that all resistors are provided with terminals of the same width.

After the terminals have been sprayed onto the ends of the rods, the rods are immersed in a moisture-repellent impregnating material such as melted carnauba wax, aerclor, halowax, sincera wax, cerawax, paraffin, linseed oil, or the like, which has no solvent action on the polymerized resin at any operating temperature. The melted wax is preferably maintained at a temperature of 170° C., and the rods are kept therein for approximately forty five minutes. Carnauba wax is particularly advantageous to use as the impregnating material since, by reason of its expansion within the interstices of the resistor rod, at temperatures below its melting point, it compensates, to some extent, for changes in resistance occasioned by temperature rise. I have also found linseed oil to be quite satisfactory, since it oxidizes and forms a surface coating which is thoroughly waterproof. Linseed oil, however, necessitates an extra baking step to effect this oxidation.

A resistor manufactured according to my improved method offers many advantages not heretofore obtained. In the first place, the process utilizes carbon which can be purchased in its processed form and is immediately available. Secondly, the resistance values can be duplicated fairly accurately and, in addition, the electrical characteristics can be accurately determined and controlled, while the finished resistors exhibit extremely low load coefficients of resistivity. Naturally, I am aware that certain of the mentioned advantages have been approached in the past, but it is my belief that no resistor now on the market exhibits them to as great an extent as a resistor manufactured according to my improved process.

Although I have disclosed herein certain specific proportions of filler, resin, and conducting material, these are given merely by way of example and are not to be construed as in any way circumscribing the scope of my invention. Many other modifications will be apparent to those skilled in the art and my invention, therefore, is not to be limited except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. An as element of a resistor device, a particle of inert, substantially non-conductive filler material, a coating of insulating material thereon, and a film of conducting material upon the outer surface of the insulating material.

2. As an article of manufacture, a resistor composed of particles of inert filler, substantially all of said particles being respectively coated with an insulating material carrying an outer film of conducting material, the films of conducting material being in intimate contact with each other throughout the mass of said resistor.

3. The invention set forth in claim 2, wherein the insulating material is a polymerized phenol formaldehyde resin.

4. The invention set forth in claim 2 wherein the conducting material films are bonded together into a quasi-honeycomb structure.

5. The process of manufacturing a material from which resistors may be formed which comprises coating a plurality of particles of inert material with an insulating layer and thereafter depositing a conducting surface film upon substantially all of said particles.

6. The process of manufacturing a material from which resistors may be formed which comprises coating the surface of a plurality of particles of inert filler material with a polymerizable material, and thereafter causing a film of conducting material to be deposited upon the surface of the polymerizable coating.

7. The method of manufacturing a material from which resistors may be formed which comprises mixing a mass of inert material particles with a solution of a polymerizable material in a volatile solvent, causing the solvent to evaporate and then applying to the surface of substantially all of said particles an adherent coating of conducting material.

8. The invention set forth in claim 7 characterized in that the inert material is a mixture of asbestos particles and ground glass.

9. The method of manufacturing a material from which resistors may be formed which comprises moistening a mass of air-floated asbestos with a solution of a phenol formaldehyde resin in a volatile solvent, causing the solvent to evaporate, mixing the residuum with a colloidal suspension of carbon, causing the carbon to be precipitated from the suspension onto the surfaces of substantially all of the particles of asbestos, and thereafter removing the remaining solute.

10. The method of manufacturing fixed resistors which comprises intimately mixing a mass of comminuted inert filler material with a solution of phenol formaldehyde resin in a volatile solvent, causing the solvent to evaporate whereby the resin is deposited as a coating upon the particles of filler, mixing the coated particles with a colloidal suspension of carbon, causing the suspension to coagulate to thereby precipitate the carbon onto the surfaces of the particles, removing the surplus vehicle of the suspension, molding the residuum into appropriate shapes, and thereafter baking the molded articles at a temperature sufficiently high and for a sufficient length of time to cause the resin to polymerize.

11. The invention set forth in claim 10 characterized in that the inert filler material is asbestos and ground glass.

12. The method of manufacturing a material from which resistors may be formed which comprises moistening a mass of inert filler particles with a solution of phenol-formaldehyde resin and a reagent capable of causing the coagulation of a colloidal suspension of carbon in a volatile solvent, causing the solvent to evaporate, and introducing the resin-coated filler particles into a colloidal suspension of carbon.

13. The method of maufacturing a material from which resistors may be formed which comprises moistening a mass of inert filler particles with a solution of phenol-formaldehyde resin and furfural in a volatile solvent, causing the solvent to evaporate, and introducing the resin-coated filler particles into a colloidal suspension of carbon.

14. The method of manufacturing a material from which resistors may be formed which includes moistening a mass of inert filler particles with a solution of a phenol formaldehyde resin and an organic acid dissolved in acetone, causing the solvent to evaporate, and introducing the resin-coated filler particles into a colloidal suspension of carbon.

15. A resistor element in the form of a rod constituted by a plurality of particles of inert filler, substantially all of said particles having a first coating of an insulating material and an outer coating of graphite and carbon black, the said particles being in such intimate contact with each other that a substantially uninterrupted electrically conductive path is established between the ends of the rod.

16. The method of manufacturing a resistor which comprises coating each of a plurality of particles of inert filler with polymerizable resin, superimposing a film of conducting material upon the resin coating, compressing the filmed particles into a coherent mass, polymerizing the resin coating to lock the particles in place and thereafter impregnating the mass with a moisture repellent material incapable of dissolving the polymerized resin at temperatures encountered during ordinary use of the resistor.

SIDNEY BLOOMENTHAL.

EXHIBIT D

IN THE COURT OF COMMON PLEAS

PHILADELPHIA COUNTY, PENNSYLVANIA

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ROBERT J. KRAUS and MARGARET M. KRAUS, h/w	:	APRIL TERM, 2018
v.	:	
ALCATEL-LUCENT, et al.	:	NO. 3448

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November 27, 2018

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Videotape trial of ROBERT KRAUS, taken pursuant to notice, was held at the offices of Magna Legal Services, 1635 Market Street, Philadelphia, Pennsylvania, commencing at 9:40 a.m., on the above date, before Melissa Broderick, a Professional Court Reporter and Notary Public for the Commonwealth of Pennsylvania.

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candidate school. If they accept you, then you go to Newport, Rhode Island, and you basically study Navy. You study leadership. You study everything you ever wanted to know about the military, what is it is and what your status in the organization and so forth. They teach you navigation and a lot of the things associated with sailing.

Q. What did -- what was your job duties in the Navy?

A. So after I graduated from OCS, I accepted the commission as an ensign. I'd actually been an enlisted man. When you go to OCS, if you fail out, you would end up in the enlisted Navy.

So I have two honorably discharges, one from there, one from officer candidate school, and the second from the Navy.

But my assignment, I was -- the day after I was commissioned, which was in June. I don't remember the exact

date, but it's in my data here -- I was ordered to report to a ship, the USS Cambria.

And it was actually a two-step process. First, I was supposed to report to training school in, I think it was, Little Creek, Virginia. Because the Cambria is an amphibious Navy -- it's one of the ships that carries the Marines -- we traveled in a squadron, and so I needed to know more about that. So they sent me to school for that.

The ship was in the Mediterranean at that time. It came back to the states. And so as the -- I was appointed the electro -- electronics material -- EMO. I think it's electronic material officer was the title they gave me. It had specific responsibilities.

Q. What were those?

A. And I was responsible for every piece of electronic equipment on that ship working constantly and regularly.

Q. Can you describe types of -- when you say electronics equipment, what are you talking about?

A. The two biggest things we had were two radars. We had an air search radar and surface search radar. The air search radar would see out about 300 miles. And that's what it did. It looked for aircraft. Also, looked for missals --

Q. Okay.

A. -- that were aimed at the ship.

We also had a piece of equipment, electronic countermeasures equipment, which was used to try to confuse any missals, if they were sent at our ship. So that's the air search radar.

We had a surface search radar, which is just as important. In my opinion, these were about two of the most important pieces of equipment on the ship, because without them, you can't

see. You can't see enemies. You can't see anything you might run into. We would typically sail darkened ship when we were in a squadron.

The brunt of the equipment was the radios. We had radio, transmitters, and receivers. Last count, we had almost -- that I did from a list I prepared -- and you've all seen that, I think -- we had over 300 -- after the ship had an overhaul, it was shortly after I went aboard the ship -- we had over 300 pieces of electronic equipment on the ship.

Q. What did you have to do with the electronic equipment?

A. It was considered a managerial job, or you could also consider it -- I mean, it was largely administrative. What I did is I actually worked -- I worked out of the ET shop.

Q. What is that?

A. Which is a shop on board the ship that was specifically for

maintaining and repairing all the electronic equipment.

And so I was responsible for making sure that all of the regulations -- and the Navy has a lot of regulations on when and where and what happens to every piece of that equipment. As a matter of fact, at one point in time, I had to sign for every piece of equipment, okay.

And so there were periodic maintenances that were required for different -- it varied depending on the piece of equipment. And we had a lot of other types of equipment, too, besides radios, but I won't go into that for this second.

But each piece of equipment had its own special card, okay. And it kept track of -- and other documents that went along with that -- kept track every time that one of those pieces of equipment came in, when it was maintained, when it was due for another

regular maintenance.

And we made changes to the equipment periodically, if it was improved or updated, and we would do some type of an alteration. A lot of these things were called ship alts.

And so I was just there for that purpose, to make sure that -- that position was to monitor, make sure that all of these things were done. If there was a particular issue with a particular piece of equipment, I had to know about it. I had to do something about it.

We've had situations where -- we had 24 landing craft on board that ship to land 1200 Marines that we carried. And the radios we were using on those boats, when we put the Marines in the water on our boats, they'd typically go out, and they would circle until they were all in this formation. They had to be able to communicate with the ship. They had to be able to communicate with each other. And they were still using

World War II radios that they were constantly breaking down.

So that was one of the things we had to find a resolution for, that is, me and -- I had the chief petty officer. That's equivalent to a sergeant in the Army, if you're not used to Navy lingo. And, eventually, to a master chief petty officer, as my ET crew grew from 12 to some higher number, 15 or so.

So it was an administrative job that doesn't sound very sexy, but it had an awful lot of problems that we had to work out.

Q. Well, you've mentioned -- used a couple of terms, and I wanted to ask you about those. You used the term "periodic maintenance" a minute ago.

A. Uh-huh.

Q. What is periodic maintenance? What happens in a periodic maintenance?

A. Typical piece of equipment -- most of the equipment on -- the

electronic equipment was rack mounted.

Q. What does that mean?

A. And that means there were literally these racks -- these structures that are like a framework. And there -- a lot of them are in the radio -- I say radio rooms. We had about -- I think, up to five radio rooms on the ship, because we were the flagship, so we carried the flag officer. He had all of his own -- duplicated everything we had except for the radars.

So maintenance, we would bring the piece of equipment in. We'd take it out of the rack. So now, where you could originally see the front panel, but you couldn't see the rest of the particular electronic equipment, when you took it out, you could see all of that because it was cabinets that enclosed it were still sitting back in the radio room.

We'd bring it down to the ET shop. And the first thing they would do

is they would clean it, okay.
Q. When they cleaned it, what did they do?
A. There were two different ways they typically cleaned it. One, they used a vacuum, and would vacuum out every part of the radio they could get to.
And the second was -- well, they used some chemicals periodically, if there was corrosion, or if there were problems with any equipment making proper contact with switches, for example, that were in there. We would -- so that was it.
DEFENSE COUNSEL: Belated objection. Overbroad as to equipment and time.
BY MR. PAUL:
Q. Why did the radios and these other pieces of equipment have to be vacuumed?
A. Easiest way to say it is they got dirty. It's like anything else

in your house, if you let it sit there for a long time -- and they were -- and they were hot, typically.
DEFENSE COUNSEL: Same objection.
THE WITNESS: Most of the radios had electronic tubes. Some had electronic tubes and transistors, a combination. And if you've ever looked in anything -- any piece of equipment, like your TV, for example, at home, it's going to get very dusty inside.
And so that's basically what they were doing, vacuuming whatever dust was in there.
BY MR. PAUL:
Q. What do you recall -- do you recall any components of these radios?
DEFENSE COUNSEL: Objection. Overbroad as to equipment and to time.
MR. PAUL: You can answer

the question.
THE WITNESS: Could you repeat the question?
MR. PAUL: Yeah. Have it read back.
- - -
(The court reporter read the pertinent part of the record.)
- - -
DEFENSE COUNSEL: Also compound.
THE WITNESS: I'm not sure what you mean by components, but, for example, there were circuit boards.
BY MR. PAUL:
Q. Circuit boards?
A. If that's what you're talking about, yeah, circuit boards.
Q. Okay.
A. The tubes themselves. They were all components. So if a tube went bad, you could pull it and replace it.
Q. Okay. Circuit boards, you

have to pull circuit boards yourself?
A. We would --
DEFENSE COUNSEL: Same objections.
THE WITNESS: There were two ways -- two kinds of ways to take care of circuit boards problems. One, you could find out if there was component that was bad, for example. Well, the tube I just mentioned. But they both have circuit boards.
But the transistor, you could detect a bad transistor and replace that. Sometimes, if you couldn't find the problem in the circuit board, then you replace it, yeah.
DEFENSE COUNSEL: Move to strike nonresponsive portions.
BY MR. PAUL:
Q. Was there any kind of cloth or pad inside the radios?
DEFENSE COUNSEL: Objection;

BY MR. PAUL:

Q. What did you do as part of that second overhaul?

A. Let me back up a little bit. So it was an unusual type of situation because we took the ship to dry dock in Philadelphia. Our home port was Norfolk, Virginia. We took the ship to the dry dock in Philadelphia, Philadelphia Naval Shipyard.

And then we kept on board the crew that was needed to do the electronic overhauls that we were going to do at that point in time. Okay. We lived on the ship. We took every piece of equipment that was on the ship, including the stuff from before -- that we had before, plus the new equipment that came aboard, and we overhauled or did whatever maintenance was needed to update the -- to make sure all of the changes to the equipment that was already on board were done.

And, effectively, we took --

except for the radars, I think every piece of equipment we had, we brought into the ET shop. And that was the main purpose for the ET shop.

DEFENSE COUNSEL: Objection; move to strike, lacks foundation.

DEFENSE COUNSEL: Move to strike nonresponsive portions.

DEFENSE COUNSEL: Can the court reporter read that last answer?

\- - -

(The court reporter read the pertinent part of the record.)

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DEFENSE COUNSEL: Move to strike speculative portions.

MR. PAUL: Okay.

THE WITNESS: Next, I heard -- are we still on?

MR. PAUL: We're still on. Yeah.

THE WITNESS: I mentioned that we didn't bring the radar in.

I think we missed that somehow, but...

THE COURT REPORTER: I said that.

THE WITNESS: Oh, you did?

THE COURT REPORTER: Yeah.

\- - -

(The court reporter read the pertinent part of the record.)

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BY MR. PAUL:

Q. All right. Well, let's talk about what was in the shop, and then we'll talk about the radar.

What did you see done in the shop during the second overhaul in 1965?

A. I lived in that shop basically. I mean, I wasn't standing watches. I wasn't doing any of my other duties. I mean, there were two rooms on that ship. You don't walk around on the ship in dry dock much. I was either in the ET shop, or I was in my room sleeping.

I saw every piece of equipment they brought in. I saw more than some of the ETs because they tend to work on certain pieces of equipment.

Q. What kind of maintenance --

DEFENSE COUNSEL: Move to strike the nonresponsive portions.

BY MR. PAUL:

Q. Okay. What kind of maintenance did you see performed on the equipment in the ET shop during the second overhaul?

DEFENSE COUNSEL: Objection; form, vague, compound, overbroad, lacks foundation.

THE WITNESS: It's a combination of different things they did. I forget the name they have for them, but they had -- I think they called them field changes. There was -- any type of a change -- as equipment aged, the Navy would make modifications. For example, they took some

radios, and they maybe replaced them with other radios that were solid state. So that would be a case where they would -- we would actually lose a piece of equipment. We'd get a substitute for it.

But for the most part, we would just look for changes that could be made in the equipment that's already on board, that would update the equipment -- particular equipment.

We had -- other things that we did, if there were any tubes -- any electronic equipments that weren't working properly, we'd service them, just the same as we would have if we were at sea. The only real difference was -- focus was that we weren't at sea.

And we brought every piece of equipment we had on board the ship because they were all -- we

could shut them all down. You can't do that when you're at sea.

BY MR. PAUL:

Q. Did you --

A. So we -- at least as a minimum, we'd take each piece of equipment, unless it had been done very recently, we'd clean it. If anything had to be adjusted, then we'd readjust it.

Q. What was the condition --

DEFENSE COUNSEL: Move to strike the speculative and nonresponsive portions.

DEFENSE COUNSEL: Can we move the microphone a little closer to the witness?

THE WITNESS: Oh, sure.

DEFENSE COUNSEL: Thank you so much.

BY MR. PAUL:

Q. What was the condition -- and this something -- we're going to go off the tape a minute -- what was the condition of the room where all this work

was going on?

DEFENSE COUNSEL: Objection; form, leading, lacks foundation, assumes facts not in evidence, vague.

THE WITNESS: It was very cluttered. It was very busy. I think we covered -- I mean, we had two long benches in the ET shop. We had -- when you have 12 ETs and -- in that space, which was a pretty good size for a ship, it was just -- it was a place you couldn't keep clean. Let me put it that way.

MR. PAUL: All right. Well, let's go off the video for a minute because we have to change the tape.

THE VIDEOGRAPHER: This concludes video 1. The time is 12:16 p.m. We are off the record.

(Off the record.)

THE VIDEOGRAPHER: The time

is 12:26 p.m. This is the beginning of video 2. We are on the record.

BY MR. PAUL:

Q. Okay. You were discussing earlier the equipment that was in the room. Okay? Are you able to -- today, to remember a specific one of the products that were -- that were on this chart that were in the room?

And I'm excluding the radar equipment for the moment.

A. Yeah, we didn't -- because we didn't bring the radar equipment in.

Q. Right. Of course, not. That's why I'm not asking about that.

A. It's too big.

I really don't, but I can say that our goal was to bring every piece of electronic equipment we had in. And even if we didn't do anything to it -- if we'd just, for example, maintained it, you know, the day before, we would at least check the card and make

going to get to that in a minute.
Do you recall being exposed to any particular ones of these products or not?
DEFENSE COUNSEL: Objection; form, vague, ambiguous, lacks foundation, calls for speculation, assumes facts not in evidence.
THE WITNESS: The answer is, no, I really don't recall any particular -- this was 50 years ago, and I have to stretch to remember some of the things I do remember. It's one of the reasons I did a lot of research.
BY MR. PAUL:
Q. Right. Well --
A. But I don't remember, you know, which equipment. I just -- all I know is all the equipment that Cambria had on board that ship was at least monitored and usually changed. But each one of them was brought down to the ET shop because everything was there for the

picking. We could take any piece of equipment.
We actually -- during this overhaul, we actually -- some of the crew from the shipyard actually moved walls. We changed some of the equipment around. Some ended up going into the flag officer's quarters -- or their offices, which are up -- high up in the ship. But every one of these pieces of equipment was there for us to take because nobody was using them. None of these people were aboard. And that's why we were very busy. And that was our function.
DEFENSE COUNSEL: Move to strike the speculative and nonresponsive portions.
BY MR. PAUL:
Q. You mentioned a radar?
A. Yeah.
Q. Is that a separate piece of equipment that was not worked on in the shop?
A. Yeah, it was too big. The

-- we had two radars, as I said.
DEFENSE COUNSEL: Objection --
THE WITNESS: The air search radar was very, very big.
DEFENSE COUNSEL: Objection; overbroad.
THE WITNESS: It had -- it was at the top of a mast. Actually, I'll just take them one at a time. That's the SPS 40. It was at the top of a mast.
BY MR. PAUL:
Q. That's the SPS 40, you said?
A. The AN SPS 40.
Q. Okay.
A. At the bottom of the mast was -- masts are huge on those ships. Okay. They're hollow. They're steel -- was a door that you -- when you opened the door -- and that's where the electronic equipment for the SPS 40 was located.
Similarly, the SPS 10, there

was another opening where that was maintained, and that was on a different mast. The SPS 40 was on one of the masts on the front of the ship. The SPS 10 was on one of the masts more near the center of the ship.
But they each had the two rotating antennas. There was a transmitter and a receiver to transmit a pulse, which would bounce off and then the receiver would receive it and amplify it. And it would show up on your -- the scanner that we had, the oscilloscope. I forget -- I forget the real name for the screen that the people that were on board -- CIC and ever who else -- we had what we called repeaters, where they could look, and they could see these blips, and they could interpret them as whatever, surface craft, aircraft.
DEFENSE COUNSEL: Move to strike the nonresponsive portions.
BY MR. PAUL:
Q. Did you, yourself, work on

the electronic equipment in the SPS 10?
DEFENSE COUNSEL: Objection; asked and answered.
MR. PAUL: No, that is definitely not asked and answered.
THE WITNESS: No, I didn't. The only time I can remember working on one of the radars was in the SPS 40.
The SPS 40, when it worked, was a beautiful piece of equipment. You could pick up a target 300 miles, which is -- back in -- I believe, in 1964, '65, that was pretty phenomenal. But it broke down all the time. And it was the most modified piece of equipment we had on the ship.
We had a field -- a field rep who came out and helped get that thing operating. If there were field changes, updates that were made -- and there were several -- that's who would do it.

It was a very, very special, state of the art in those days, piece of equipment.
DEFENSE COUNSEL: Move to strike.
THE WITNESS: And one time -- I did go out at least once -- but the captain was very, very upset when that was down.
And so I was on the field rep's back. If he was down there in that little room working on the radar system, I'd want to know what the problem is, how long is it going to take, do you have the parts that you need to repair it, and so forth, because -- just because of the captain. It was that and the other radar, the surface search radar, were two vital pieces of equipment that they didn't want to be without.
DEFENSE COUNSEL: Move to strike the nonresponsive portions.

BY MR. PAUL:
Q. Do you remember who -- what company the field representative worked for, for the SPS 40?
DEFENSE COUNSEL: Objection; leading, lacks foundation, calls for speculation.
THE WITNESS: I want to say Raytheon. I'd have to go back and look. Because I actually found documents that showed all the different versions of the SPS 40 radar.
And I looked for the version when I was on board, and it definitely wasn't all solid state. It was partially tubes. It had a magnetron.
But I think we have -- in our records there, we do have -- matter of fact, I could look on here and see.
MR. PAUL: That's all right. I'm not asking what you --

DEFENSE COUNSEL: Move to strike speculation and nonresponsive portions, improper refreshing of recollection.
THE WITNESS: No, it was the SPS 10 that was Raytheon. The SPS 40 --
DEFENSE COUNSEL: Improper refreshing of recollection.
THE WITNESS: -- I think it started out with Lockheed Martin, but then when they -- the company started to get sold and bought by other companies. It changed hands.
BY MR. PAUL:
Q. So you were --
DEFENSE COUNSEL: Move to strike speculation and nonresponsive portions.
BY MR. PAUL:
Q. How did you know that it was a Lockheed representative on the SPS --
DEFENSE COUNSEL: Assumes

facts not in evidence --
MR. PAUL: Excuse me. I'm not finished asking my question. Could you please wait?
BY MR. PAUL:
Q. How did you know? Did he have a logo? Did he have a uniform? Did he give you a business card? How did you know?
DEFENSE COUNSEL: Same objections.
THE WITNESS: He was the only guy on board in civilian clothes. How about that?
DEFENSE COUNSEL: Same objections.
THE WITNESS: He was -- I worked with him when he came on board. He came to see me. I mean, that was part of my function. Okay? And so I knew who he was.
He didn't get to our ship a very easy way. Very often, he was

transferred from another ship or a helicopter to get to us.
BY MR. PAUL:
Q. Do you remember his name?
A. It wasn't always the same guy.
Q. Oh, it was not always the same guy?
A. Yeah.
Q. Well, so the SPS 40 wasn't worked on just one time in your presence? It was worked on more than once?
A. Worked on a lot. Worked on a lot.
DEFENSE COUNSEL: Objection; leading.
THE COURT REPORTER: Can you say -- I didn't hear your answer.
THE WITNESS: Oh, it was worked on a lot, yeah. It was --
BY MR. PAUL:
Q. How often was the electronics worked on, on the SPS 40, in your presence?

DEFENSE COUNSEL: Objection; vague, ambiguous, overbroad.
THE WITNESS: Well, it was only the one time that I know of that I was down there when they --
BY MR. PAUL:
Q. Okay.
A. -- opened it up.
Q. Okay. Were you ever in the other parts of the ship, like the engine room or the fire rooms?
A. When I went aboard the ship, I was given a complete tour. That included the engine room.
Q. Okay.
A. And the one thing I learned about the engine room is that I never wanted to go back there again. It was like 110 degrees and super dry. It's not the kind of place you want to go.
Q. Okay. I got you.
A. We used -- but we used cooling air from, like, in the winter, for example --

Q. Uh-huh.
A. -- to help cool that part of the ship.
Q. Okay.
A. In other words, it's part of the ventilation system that we had which was --
Q. Was there any deck work or insulation of pipe work done in your vicinity?
A. Not that I recall.
Q. All right. Have we now talked about everything that you did in the Navy, or have we missed any jobs or activities that you had in the Navy?
A. Well --
Q. We've talked about the watch officer. Other than that -- and you talked about that, as well as the electronic work. Anything else other than the electronic work and the watch officer work that you can recall?
A. Yeah. I'm not sure this is really -- well, the other job I had was

EXHIBIT E

NAVSHIPS 92441.42

Non-Registered

"APPROVED MANUSCRIPT"

MAINTENANCE STANDARDS BOOK

for

RADIO SETS AN/SRC-13, -14, -15

SERIAL NO.________

OF MODEL________

RCA SERVICE COMPANY

GOVERNMENT SERVICE DEPARTMENT

CAMDEN, NEW JERSEY

DEPARTMENT OF THE NAVY

BUREAU OF SHIPS

Contract: NObsr 71524 — *Approved by BuShips: 28 May 1958*

STEP 21Q

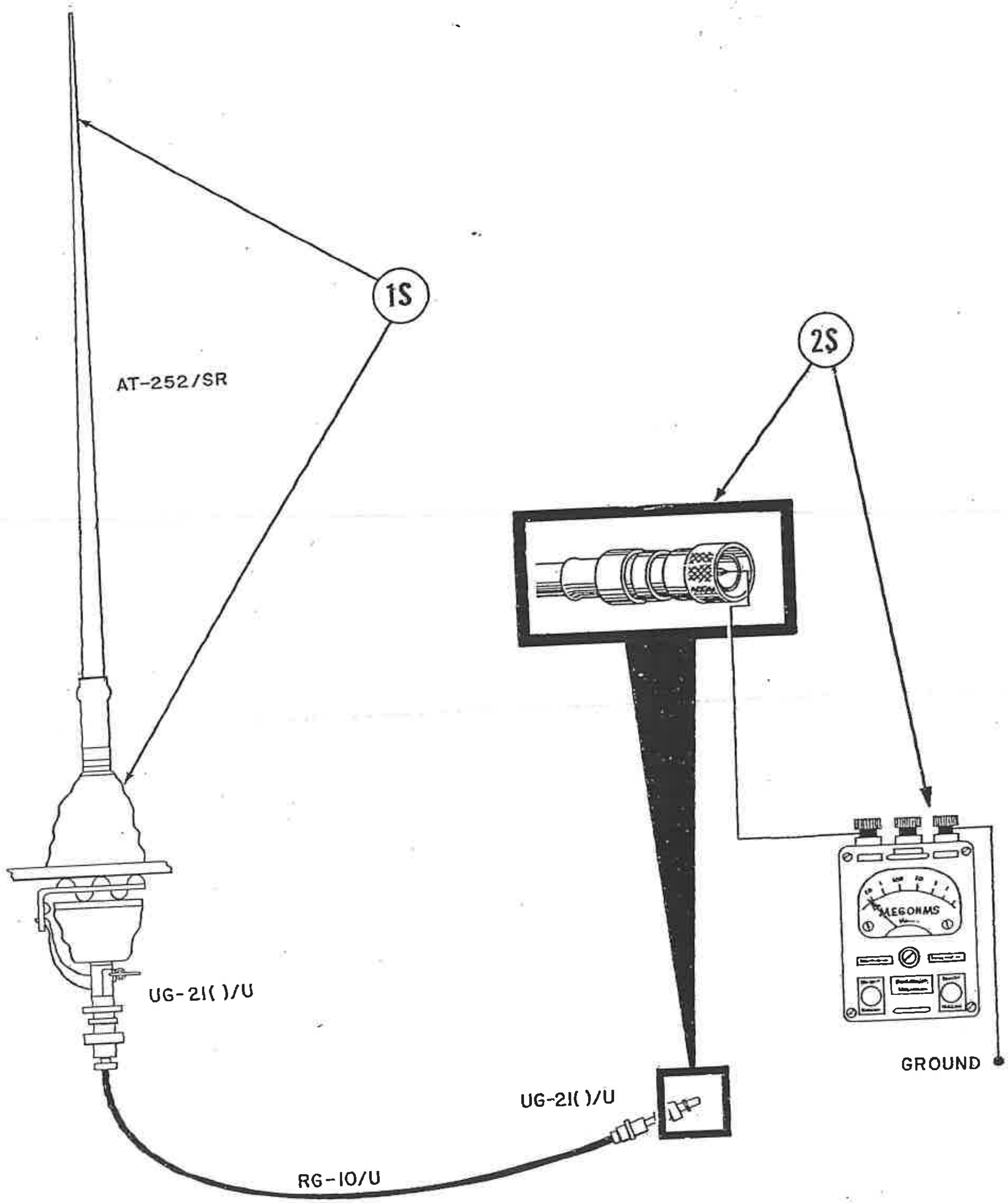
AN/SRC Completely De-energized.

STEP NO.	ACTION REQUIRED	PROCEDURE
21Q	Inspect the equipment for mechanical faults.	Inspect the ground clamp and ground straps for clean, tight connections. Clean and tighten cup insulators and bushings. Inspect the operation of the shock mounts. Inspect cables, plugs, connectors and receptacles for cracked or defective insulation. Straighten cable kinks and remove improper supports. Inspect the terminal boards (including terminal boards in junction box of mounting MT-327/GR, MX-1583/SRC (if used) and Control Box C-375/VRC). Clean corroded connections with crocus cloth. Inspect all switches for proper action, evidence of arcing and tight connections. Inspect all potentiometers for broken parts, loose connections and loose or missing control knobs. Inspect the mechanical tuning and detent assemblies for loose or broken parts and for dirt, rust or corrosion. Clean, tighten and replace all defective parts.

STEP NO.	1st QUARTER		2nd QUARTER		3rd QUARTER		4th QUARTER	
	Initial	Date	Initial	Date	Initial	Date	Initial	Date
21Q								

STEP NO.	5th QUARTER		6th QUARTER		7th QUARTER		8th QUARTER	
	Initial	Date	Initial	Date	Initial	Date	Initial	Date
21Q								

STEP (1S)



STEP 1S

O.M. - Designates Operational Maintenance

STEP NO.	ACTION REQUIRED	PROCEDURE
1S O.M.	Inspect and clean the Antenna mast section and base.	Unscrew the mast section from the mast base. Clean each mast section and antenna cup insulators with soap and water. Remove all salt and soot deposits, rinse with clear water and dry thoroughly. Inspect the mast section for rust and corrosion, particularly at the threaded connector. Remove all foreign material with crocus cloth or by careful scraping. Remove the ground strap and the ground clamp at the Antenna cup insulator. Clean and replace parts as necessary for a clean, tight connection. Inspect the cable connector at the Antenna base. Remove all foreign matter that would prevent a good electrical connection.

STEP NO.	1st HALF		2nd HALF		3rd HALF		4th HALF	
	Initial	Date	Initial	Date	Initial	Date	Initial	Date
1S								

NAVSHIPS 91420.41

Non-Registered

"APPROVED MANUSCRIPT"
MAINTENANCE CHECK-OFF BOOK
for

SONAR SOUNDING SETS AN/UQN-1B, AN/UQN-1C

MODEL NO.________

SERIAL NO.________

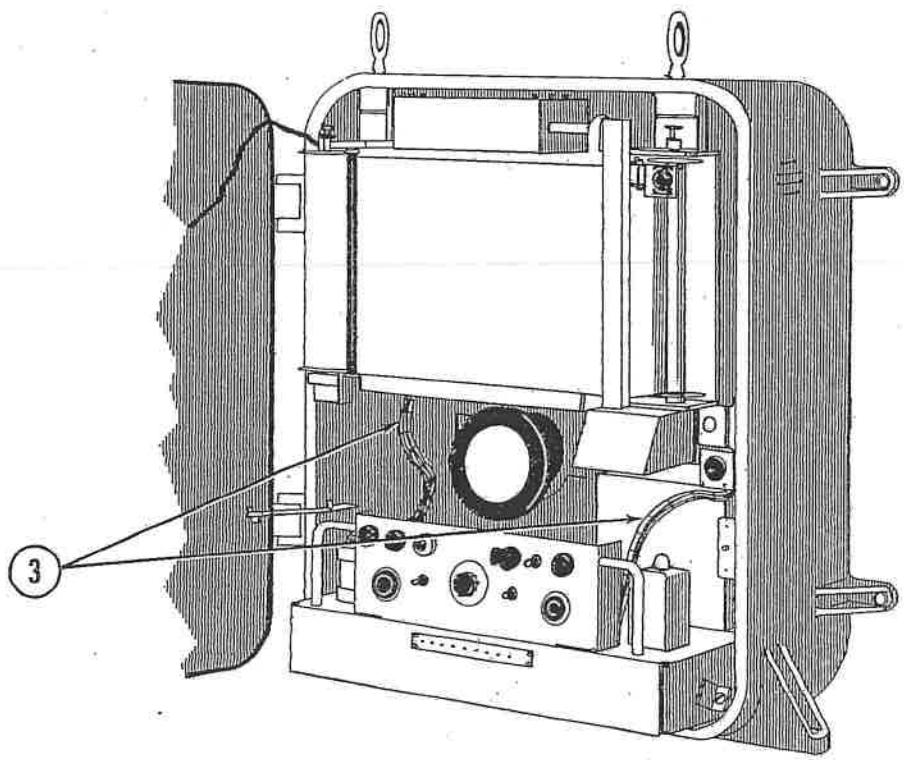
RCA SERVICE COMPANY, INC.
GOVERNMENT SERVICE DEPARTMENT
CAMDEN, NEW JERSEY

DEPARTMENT OF THE NAVY
BUREAU OF SHIPS

Contract: NObsr 63505 *Approved by BuShips: 6 September 1955*

1 CLEAN EQUIPMENT

2 INSPECT ALL CONTROLS



SONAR SOUNDING SET
CABINET DOOR OPEN

Sonar Sounding Set de-energized
Front cover open

STEP NO.	ACTION REQUIRED	PROCEDURE
1	Clean equipment.	Clean inside of cabinet with vacuum cleaner. Withdraw and invert Receiver-Indicator chassis and vacuum. All dirt must be removed from switches, terminal boards, and tube sockets. If all dirt cannot be removed by vacuuming use dry brush to loosen or remove deposits. Any remaining deposits are best removed with a clean lint-free cloth which has been moistened with Dry Cleaning Solvent 140-F Fed. Spec. P-S-661 type II (5 gal; SNSN G51-S-4718-10). Corrosion must be removed whenever it becomes evident. Connectors, terminals, jacks, etc. can be polished with crocus cloth or #0000 sandpaper in especially stubborn cases.
2	General mechanical inspection.	Visually inspect the mechanical action of all controls. Clean with Dry Cleaning Solvent 140-F Fed. Spec. P-S-661 type II (5 gal; SNSN G51-S-4718-10) if sticking occurs. Check that all mountings and connections are tight. All shafts should rotate freely. All switches must be inspected for damage due to arcing. When it is necessary to burnish contacts use a burnishing tool.
3	General electrical inspection.	Note and replace charred wiring, burnt or discolored resistors, and bulged or broken capacitors. Inspect all cables and wiring for frayed, cut, deteriorated or cracked insulation, kinks or strains.

STEP NO.	Month	JAN 19__	FEB 19__	MAR 19__	APR 19__	MAY 19__	JUNE 19__	JULY 19__	AUG 19__	SEPT 19__	OCT 19__	NOV 19__	DEC 19__
1	Initial												
	Date												
2	Initial												
	Date												
3	Initial												
	Date												

DATE: 1 July 1964

ITEM NAME: TRANSPONDER SET

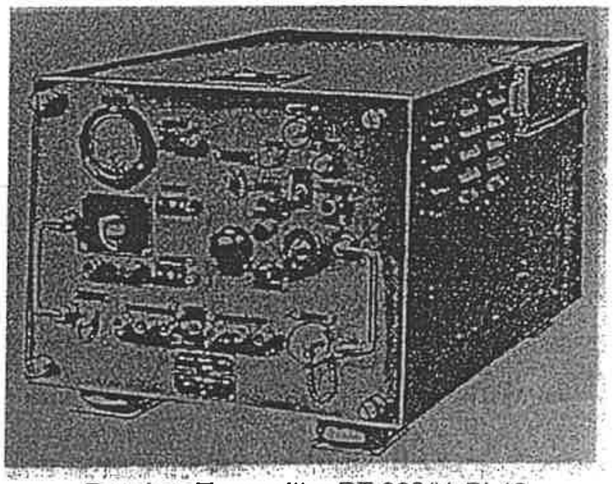
COGNIZANT SERVICE: USN

TYPE: AN/UPX-12, * -12A, ** -12B***

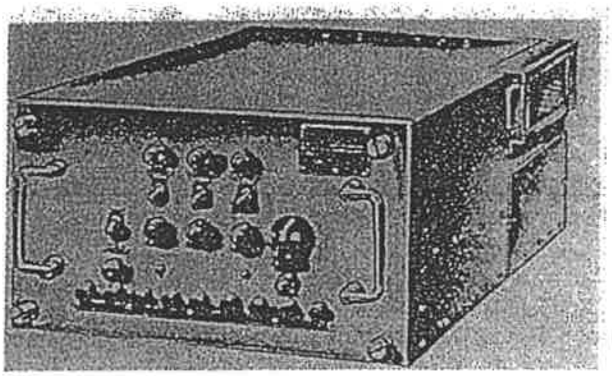
FEDERAL STOCK NUMBER:

	USA	USN	USAF	USMC
STATUS OR TYPE CLASSIFICATION		Sub. Std		

Mfg(s) Name or Code Number: General Electric Company*; Radio Receptor Company, Inc.**



Receiver-Transmitter RT-38?()/uPI-12



Decoder KT-200()/UPY-12

FUNCTIONAL DESCRIPTION

Transponder Sets AN/UPX-12, -12A, and -12B respond to appropriate interrogations from Radar Recognition Sets for the purpose of self-identification. They receive paired-pulse interrogation signals and transmit single-pulse identifying replies. Interrogations are pulse-pairs in one or more of three modes as determined by the spacing of the pulses in a pair. Replies to all modes are single, one-microsecond pulses.

RELATION TO SIMILAR EQUIPMENT

Similar to the AN/UPX-5, -5A, and -5B equipments.

TECHNICAL DESCRIPTION

Frequency: Receiver, 1010 to 1030 mc;
transmitter, 1090 to 1110 mc
IF. Frequency: 59.5 +1.5 mc
Bandwidth: 8 to 11 mc at 6 db down
Duty Cycle: 0.1% while carrying pulses of 10-kw peak power
Minimum Output: 300w at 500 pps
Pulse Width: 0.9 to 1.3 -sec (50% of peak amplitude)
Operating Voltages and Power Requirements:
105 to 125v, 57 to 63 cps or 360 to 440 cps, 1-ph, 398w approx

INSTALLATION CONSIDERATIONS

Siting:
Mounting:
Cabling Requirements: Cables must enter the cases without sharp bends. Interconnecting cables between receiver-transmitter and decoder must not exceed 20 feet. The antenna cable must not exceed 150 feet and other cables should not exceed 300 feet in length.
Related Equipment:

AN/UPX-12, -12A, -12B

PRINCIPAL COMPONENTS AND PHYSICAL DATA

COMPONENT	QTY	HEIGHT (Inches)	WIDTH (Inches)	DEPTH (Inches)	UNIT WT. (Pounds)
AN/UPX- 12					
Receiver-Transmitter RT-387/UPX- 12	1	15-1/2	18	28-3/8	141
Decoder KY-200/UPX-12	1	10	18	26-5/8	101
Video Coder KY-136/UPA-38	1				
Radar Set Control C-1047/UPA-38	1				
AN/UPX- 12A					
Receiver-Transmitter RT-387A/UPX- 12	1				
Decoder KY-200A/UPX-12	1				
Video Coder KY-136/UPA-38	1				
Radar Set Control C- 1047/UPA-38	1				
AN/UPX- 12B					
Receiver-Transmitter RT-387B/UPX-12	1				
Decoder KY-200B/UPX-12	1				
Video Coder KY-136/UPA-38	1				
Radar Set Control C-1047/UPA-38	1				

REFERENCE DATA AND LITERATURE

Technical Manual:
NAVSHIPS 92820

EXHIBIT F

ORIGINAL

WILLIAM T. COVALESKI, et ux.
Plaintiff (s)

-vs-

ALLIED CORPORATION, et al.
Defendant (s)

: COURT OF COMMON PLEAS
: PHILADELPHIA COUNTY
:
:
: MARCH TERM, 2003
:
:
:
: NO. 4332

- - -

Videotape deposition of WILLIAM T. COVALESKI, taken pursuant to notice, held at the Sheraton Park Ridge Hotel, 480 N. Gulph Road, King of Prussia, Pennsylvania 19406, on Tuesday, May 20, 2003, beginning at or about 11:20 a.m., before Wanda M. Barnum, Court Reporter and Notary Public, and Robert Higham, Videotape Operator, there being present.

- - -

APPEARANCES:

HOWARD, BRENNER & NASS
BY: EDWARD M. NASS, ESQUIRE
1608 Walnut Street
17th Floor
Philadelphia, Pennsylvania 19103
Phone: (215) 546-8200
Representing the Plaintiffs

McCARTER and ENGLISH, LLP
BY: EVOLEA C. WATSON, ESQUIRE
Mellon Bank Center
Suite 700, 1735 Market Street
Philadelphia, Pennsylvania 19103
Phone: (215) 979-3800
Representing Defendants,
AO Smith, Owens-Illinois, Inc.

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the record or objection off the video? Or speaking objection?

MR. NASS: I think for the purposes of the video, if there's an objection, I think we should go automatically off the tape. We'll see how that goes there. I try not to ask a lot of objectionable questions, but --

A DEFENSE COUNSEL: Counsel, is it your intention that instead of a cross-examination on video, we will incorporate by reference our discovery deposition?

MR. NASS: Absolutely. I think the rules permit that anyway for the discovery deposition will be used as, you know, at trial, however counsel wishes, but I'm agreeing to that on the record, too, that you don't need to repeat the questions on the videotape that you've asked on discovery.

THE VIDEOTAPE OPERATOR: We're on the video record.

This is a videotape deposition for Court Common of Pleas, Philadelphia County, Pennsylvania.

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My name is Robert Higham. I'm the videotape operator. I'm employed by Knipes-Cohen Spherion, Registered Professional Reporters, 400 Market Street, Philadelphia, Pennsylvania 19106.

The court reporter is Wanda Barnum.

The caption for today's case is as follows: William T. Covaleski versus Allied Corporation, et al., March Term, 2003, Number 4332.

This deposition is being taken on behalf of the Plaintiff at the Sheraton Park Ridge, 480 North Gulph Road, King of Prussia, Pennsylvania.

Appearances are Edward N. Nass, Esquire, attorney for the Plaintiff. All Defense counsel will be reflected on the stenographic record.

The Deponent today is William Covaleski.

Today's date is May 20 2003. The time is 11:21.

The reporter will now swear in the witness.

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THE VIDEOTAPE OPERATOR: Off the video record. The time is 11:22.

THE VIDEOTAPE OPERATOR: Back on the video record. The time is 11:22.

The reporter will now swear in the witness.

- - -

WILLIAM T. COVALESKI, after having been duly sworn, was examined and testified as follows:

- - -

EXAMINATION

- - -

BY MR. NASS:

Q. Would you please state your full name for the record?

A. William Thomas Covaleski.

Q. Good morning, Mr. Covaleski. As you know, my name is Edward Nass, and I am representing you in connection with this matter.

Now right now the jury can see you on this videotape but they cannot see me, and they cannot see other counsel. But we're all here today to take your testimony in

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connection with the claim that has been brought by both yourself and your wife, Dorothea, okay? Are you ready to proceed?

A. Yes.

Q. Okay. First of all, will you tell us where it is that you live?

A. I live at 3420 Waterstreet Road in Collegeville, Pennsylvania.

Q. All right. And about how long have you lived in Collegeville?

A. Thirty years.

Q. And what is your age, sir?

A. Seventy.

Q. And can you give us your date of birth?

A. 9/22/32.

Q. And where were you born in 1932?

A. Mount Carmel, Pennsylvania.

Q. What part of the state is that?

A. It's in Butler Township.

Q. Okay. Up sort of in the Poconos is that?

A. Not quite. It's northwest of there.

Q. Okay.

A. Towards the middle of the state.

Q. Where did you end up going to high

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school?
A. Northeast Catholic in Philadelphia.
Q. All right. How old were you when you moved to Philadelphia? Approximately how old were you?
A. Nine years old.
Q. Did you end up graduating from high school?
A. Yes.
Q. Mr. Covaleski, are you married?
A. Yes.
Q. And what is your wife's name?
A. Dorothea.
Q. And is she here in the room today?
A. Yes, she is.
Q. What year did you and Dorothea get married?
A. 1957.
Q. So you've been married, I guess, 45, 46 years?
A. Years.
Q. Okay. Do you have any children?
A. Three.
Q. Boys, girls?
A. Two girls and a boy.

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Q. How about you give us their names and approximate ages?
A. Suzanne Salmon, 46. Lisa Windegrad, 45. And William J. Covaleski, 40.
Q. Any of your children here today with us?
A. Yes.
Q. Okay. Who is with us?
A. Suzanne Salmon.
Q. You have three children. Do you have any grandchildren?
A. Six.
Q. Okay. Mr. Covaleski, are you presently employed or retired?
A. I'm retired.
Q. Okay. When was it that you retired?
A. 1989.
Q. And what company did you retire from?
A. General Electric.
Q. How long did you work for General Electric all together?
A. Approximately 32 -- 33 years.
Q. So you've been retired now for 14, 15 years?
A. Fourteen and a half years.
Q. Okay. Until recently, how was your

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health during your retirement?
A. Fine.
Q. Mr. Covaleski, how is your health at the present time?
A. Not too good.
Q. Why not?
A. I've been under treatment for cancer. I've gone through forty treatments of radiation and eight treatments of chemo. And this coming week I start back on chemo again.
Q. What type of cancer do you have?
A. Lung cancer.
Q. And do you know in which lung you have this cancer?
A. Right.
Q. Approximately when was it that you first found out that you had the cancer?
A. This past February.
Q. That would be about three months ago?
A. Three months ago.
Q. Mr. Covaleski, will you tell the members of the jury the events that led up to the discovery of your lung cancer?
A. I went to my primary physician somewhere in January, and my complaint was that I was

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coughing up clear phlegm. He knew that I had an X-ray done two years previously and it showed a touch of emphysema. So he just blew it off as a touch of emphysema.
Couple weeks later I went back to him. And, according to him, I have an infection in my lung, which I was coughing up green and yellow phlegm. He gave me antibiotics, and that went on for about three weeks and that cleared up, but I was still coughing up clear phlegm.
I went back to him. He suggested I get an X-ray. And I had one two years before that and it didn't show anything. And here the X-ray indicated a dark spot on my lung. So he suggested I have a CAT scan.
I had the CAT scan, and that showed definitely I had possibly cancer. So arrangements were made for me to go to Fox Chase Cancer Center, which four doctors examined me and diagnosed that, yes, I had a tumor on my lung and I -- it spread up to my lymph nodes in my neck.
Q. Mr. Covaleski, when you were first told that you did in fact have cancer, what was

asbestos with Igo?
A. No, I think that's about it.
Q. What was your next job after Igo?
A. I went with General Electric.
Q. Okay. And when was it that you started with General Electric?
A. 1956.
Q. Do you remember the month?
A. Yes, November.
Q. And is General Electric the company that you stayed with until you retired?
A. Yes.
Q. And I believe you told us --
A. Thirty-two years.
Q. And you retired in 1988?
A. Correct.
Q. So we have '56 to '88?
A. Yeah.
Q. Now, in November of 1956, which General Electric plant did you work at?
A. At the Space Division. It was a brand new division. It was the beginning of the space industry at 32nd and Chestnut.
Q. Okay. I guess this was right around the time that Russia put Sputnick up, right?

A. Yeah.
Q. Okay. And that General Electric plant you said was at what address?
A. 32nd and Chestnut Street.
Q. Is that plant still there today?
A. No. They moved out of there ten years ago and it was sold and I think it's condominium apartments.
Q. How long did you actually work at the GE plant at 32nd and Chestnut?
A. Twelve years.
Q. Until what year? You started in '56 there.
A. About '68, I guess.
Q. What was the size of the GE plant at 32nd and Chestnut?
A. It was a city block by two city blocks by ten stories high.
Q. And what were they actually making at this space division plant when you were there?
A. Nose cones for the missiles.
Q. When you started at General Electric in November of 1956, what was your first job?
A. Pipe fitter.
Q. And how long did you work as a pipe

fitter at that GE plant?
A. Approximately five years.
Q. That takes us up to what year?
A. '61.
Q. During those five years that you worked as a pipe fitter at General Electric, generally speaking, can you tell the members of the jury what your duties were?
A. The building was supplied with steam heat. And all steam pipe is covered with insulation, specifically with asbestos insulation. And that's three days out of five days I worked on the steam lines because I was either repairing or replacing or maintenance.
Q. Where were these steam lines in the facility?
A. They ran through -- there was a sixteen inch line that came in the building supplied by Reading Railroad. And then it branched off throughout the whole building. All the perimeters had wall radiators. And then when they were installing air conditioning through the whole building, each unit, which is approximately twenty ton units throughout the whole building, were supplied with steam coils

in there for heating.
Q. And as a pipe fitter at General Electric specific to this piping that ran throughout the plant, what were your duties?
A. Repairs, replacements, installation. There was always constant work on it. And you pulling off the insulation and then you would always patch it back up again. Or installation, if you ran a new line, you would automatically insulate it.
Q. Did you work on anything else there other than piping systems?
A. Yeah, plumbing.
Q. Did you work on any equipment, any types of equipment at the General Electric plant?
A. Yes.
Q. As a pipe fitter?
A. Yes.
Q. Give us some examples of the type of equipment.
A. Temperature, humidity chambers, which were pipe with water glycol. Anything that kept water or what have you going through it.
Q. Mr. Covaleski, in connection with your five years of work at the General Electric

plant as a pipe fitter between 1956 and 1961, were you exposed to any asbestos dust from any asbestos-containing products?
A. Quite a bit.
Q. All right. And can you describe to the members of the jury generally speaking how you would be exposed to asbestos in connection with this work?
A. First of all, with the asbestos covering. And most of the asbestos covering was made by --
MS. WATSON: Objection.
BY MR. NASS:
Q. You can't tell us right now the manufacturer's name. We'll get to that later. Go ahead.
A. It was pipe insulation. They called it half moon. And it came in various sizes, from half inch all the way up to sixteen inch. And there was a specific spot in the building, it was the penthouse on a roof they stored it because of the dust problem. And when the material came in receiving, they took it right up to the roof, and that's where it was stored, and they had racks with all different

sizes. And then they had fifty-five gallon drums and they had skids of loose asbestos, which you would tear open the bag and then dump it into the fifty-five gallon drum. And any time you had to mix some up, you would just get a two and a half gallon bucket and scoop out whatever you needed. And the floor was always covered with dust.
Q. Going back to that half moon insulation that you were describing -- first of all, how do you know that that product was made of asbestos?
A. It was an unwritten law in pipe fitting that anything that you had to do with steam had to have asbestos covering for the insulation purposes.
Q. Any other reasons that you know also that that pipe covering contained asbestos?
A. From day one it was the only thing available.
Q. Okay. The -- would you personally handle the pipe covering?
A. Oh, yeah.
Q. And would you have to do anything with that pipe covering before you installed it?

A. Cut it, fit it, mix up the loose asbestos for all the fittings and joints.
Q. What would you cut the half moon pipe covering with?
A. Saw.
Q. All right. And what would happen when you sawed the pipe covering?
A. All kind of dust.
Q. Would you breathe in that dust?
A. Yeah. Never had masks.
Q. You mentioned also the loose form of asbestos. What was that actually used for by pipe fitters?
A. To cover the joints.
Q. All right. And joints are what?
A. The elbows and the T's.
Q. Are you referring -- when you refer to elbows and joints and T's, are those parts of a piping system?
A. Piping system, yes.
Q. And did you personally mix loose asbestos?
A. All the time.
Q. All right. And what would happen when -- did that product come dry or premixed?

A. Dry.
Q. And what would happen when you mixed the dry substance?
A. It would just be so flaky. It would just carry right through in the air.
Q. In connection with your work as a pipe fitter at General Electric, were there any other types of asbestos-containing products that you personally handled other than pipe covering and loose asbestos?
A. Gaskets.
Q. Okay.
A. Sheet gaskets, pre-punched gaskets. Most of your fittings three inches or over were all flange gaskets and you would have premade gaskets, four hole, six hole, whatever the diameter and whatever the arrangements of the bolts were. Sometimes we would punch out our own gaskets. In most cases they would be premade pre-punched gaskets.
Q. And the gaskets were used where?
A. On the fittings where they bolted them together. You had two flush surfaces, and the gasket went in between to prevent it from leaking.

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Q. We've talked about pipe covering. We've talked about loose asbestos. We've talked about gaskets. Any other types of asbestos-containing products that you personally handled?
A. Gaskets themselves for different type pumps, different type connections.
Q. Anything else that comes to mind right now?
A. String gasket, rope gasket. Any time you took a pump apart, obviously you replaced all the gaskets and replaced all the packing in there because you wouldn't reuse it again.
Q. The -- tell me what this rope product looked like.
A. It came in different diameters and strings. It was like a rope. That's why they called it. And then it was like an eighth of an inch in diameter. So if you were packing something and it was an eighth of an inch opening, you would just take one string and wrap it around until you got that area of packing material to where you want it. And then you would connect whatever connection it was to it.

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If it were thicker than that half inch -- in most cases if you had like three-eighth or half inch, you'd get the regular packing material three-eighth or half inch by three-eighth -- half by half or half by three-eighths. But if not, you could use the rope material and wind it up and then pack it in there.
Q. All right. Going back to the gasket material you're talking about, you were talking about the sheet form of gasket. What would you have to do with the sheet form of gasket?
A. You would cut it to the size, whatever. Like say it's a six inch value, and you would cut a piece approximately eight inches or so. And if you had the valve there or something there, you could actually put it over and just with a ball peen hammer go around the edges inside and outside and all the bolt holes and just keep on tapping and -- otherwise, we had tools, different diameters for cutting the gaskets.
Q. And what would happen when you would cut the gasket material?

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A. It would actually flake off.
Q. All right. And would you be exposed to that?
A. Oh, definitely.
Q. The -- going back now to the rope material and this string material, would you have to ever cut that?
A. Yes.
Q. All right. And what would you cut that material with?
A. With a knife.
Q. And what would happen when you cut the rope material?
A. Same way. It would fray at the ends.
Q. You've taken us up to as a pipe fitter. What happened in 1961?
A. I was promoted to foreman on second shift.
Q. Still at the same plant?
A. Still at the same plant.
Q. All right. And as a foreman, who were you supervising?
A. I was supervising plumbers, pipe fitters, electricians and carpenters. Complete maintenance group.

Page 41

Q. All right. And how long did you work as a foreman of the maintenance group at that GE plant?
A. Approximately seven years.
Q. And what were your day-to-day duties as a foreman?
A. Supervising all the maintenance and repairs, get work orders, start the shift, hand the work out. And then during the night, we would go around checking on the jobs to make sure everything is running smooth.
Q. Now, during that seven-year period that you worked as a foreman, were you exposed to any asbestos dust from any asbestos-containing products?
A. Yeah, when the pipe fitters were working on steam lines, which it seems every night there was a job -- a repair job of some sort.
Q. The -- during that period from '61 to '68, were you doing any hands-on work or were you doing all supervision?
A. No.
Q. So then --
A. All supervision.
Q. All right. So during that period, you

Page 42

would have not been personally handling the asbestos yourself?
A. Correct.
Q. Okay. In terms of the types of asbestos that your crew was using, was it similar or different than what you used as a pipe fitter?
A. Exactly the same thing.
Q. Where did you go to work for General Electric in 1968?
A. I was transferred up to Valley Forge.
Q. And how long did you end up staying at the Valley Forge facility all together?
A. Eighteen years in this one building.
Q. When you retired, were you working out of Valley Forge?
A. No. Yes, in Valley Forge, but I was in another building because it was the end of the coal war and we were making nose cones for the minuteman missile in that plant.
So, at the end of the coal war, the government stopped making minuteman missiles. So the plant -- the contract was cancelled and the plant closed. And then I went to another building for approximately two, three years before I retired.

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Q. What kind of work did you do up at Valley Forge during this 1968 period to 1988?
A. I was a supervisor. I had three foremen under me. So --
Q. And once you got up to the Valley Forge facilities, were you exposed to any more asbestos?
A. No, no more asbestos.
Q. Mr. Covaleski, besides your regular work with Igo that you've told the jury about and then with General Electric, did you ever do any moonlighting or work at any second jobs?
A. Yes.
Q. Tell the members of the jury about that.
A. This was approximately at the time where all the boilers and all the heat in Philadelphia was coal heat, and most of the houses were heated by coal, hot water boilers. And that's when they came out in '46, '47 with gas boilers. So the trend was to get rid of all the coal. Nobody wanted the coal anymore. So they were all replacing coal furnaces with gas. So being that that's what I was doing, I start working on the side on

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weekends replacing coal-fired boilers with gas-fired boilers.
Q. All right. Were you doing this work with anyone or just --
A. Yes, a friend of mine.
Q. What was your friend's name?
A. Dan Friel.
Q. All right. And for -- and what decade are we talking about?
A. We're talking about '52 to '58.
Q. All right. And the -- how many furnace jobs would you do doing the side work on a per year basis during that '52 to '58 --
A. Usually we started around April, May after heating season. And I would say we would do one a week for -- up until October.
Q. All right. Now, in connection with the installation -- the replacement of these coal furnaces and the installation of these new furnaces, were you exposed to any asbestos dust from any asbestos-containing furnaces?
A. All the coal, and they had some oil burners, all of them were completely covered with asbestos plastered on there. And to get the boilers out we had to bust them apart. So

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we would just tear off all the insulation and all the boilers were cast-iron heavy. And we just sledge hammered them apart and then the scrap man would come in and take it out.
Q. Now, you've told us about exposure that you had on your regular job. You told us now about some exposure that you had in connection with the side work.
Were you ever exposed to asbestos in any other ways off the job?
A. Yes.
Q. How?
A. Working on cars.
Q. How were you exposed to asbestos working on cars?
A. Replacing the brakes. Most of the time that's where I was exposed to it.
THE VIDEOTAPE OPERATOR: One moment, please. Off the vide record. The time is 11:57.
THE VIDEOTAPE OPERATOR: Back on the video record. The time is 11:57.
BY MR. NASS:
Q. How old were you when you started changing brakes on automobiles?

EXHIBIT H

Faherty - 2
11/25/19
Lori A. Zabielski, RPR

ROBERT J. KRAUS and
MARGARET M.KRAUS, h/w

Plaintiff,

Index No. 18-2119

-against-

EXPERT AFFIDAVIT

ALCATEL-LUCENT, ET AL,

ASBESTOS CASE

Defendants

STATE OF WASHINGTON)
) SS:
COUNTY OF KING)

Arthur W. Faherty, being duly sworn upon his oath deposes and says:

1. I have been employed for many years in the fields of U.S. Navy equipment, and in the applications of U.S. Navy requirements under military specifications, usually referred to as mil specs and the issuances of the Secretary of the Navy and his designees and assignees and subordinates.
2. I am familiar with procedures for both new construction and repair of Navy and commercial vessels.
3. A copy of my CV is attached hereto and incorporated herein by reference as Exhibit A.
4. I have considerable experience in the interpretation of military and Navy documents.
5. I am aware of the Navy specification for the equipment for World War II era ships and later, known as General Specification for Machinery Sub S1-1 page 2.
6. These specifications required warnings and safety precautions.
7. I am aware of the Specifications for Shipyard Contracts.
8. I am familiar with MIL-M-15071, which was the military specification and its successors, including 15071A-C and the specifications referenced in paragraph 5 of that document. MIL-M-15071A-D is roughly the same and involves similar requirements.
9. 15071 states that the intent of the Navy was to accept the usual commercial manuals when roughly equivalent to the overall requirements of Navy.
10. Mil Spec 15071-D was later succeeded by MIL-15071E.
11. 15071D required submission of the manual to the Bureau of Ships which would then adopt the manual as a Navy document.
12. 15071D required manuals to contain safety precautions. (Section 3.1.9)

AWF

13. 15071D required that all manuals must contain notes, cautions and warnings to emphasize critical instructions. (Section 3.3.6)
14. Included in 3.3.6 (c) is the definition of the term "warning" which is defined by the Navy as operating procedures and practices which will result in personal injury or loss of life if not correctly followed.
15. 15071D Section 3.1.7 requires instructions to include precautions.
16. I am familiar with the duties of EMO (Electrical Material Officer) and of the ET ratings, seaman through CPO (Chief Petty Officer).
17. Plaintiff served on board the USS Cambria, as EMO from July 1964 to May 1967.
18. I have reviewed the following documents:
    a. 180823 and 190415 Alphabetic list of Cambria Electronic Equipment
    b. Electronics Material Officer Course Information
    c. Electronic Technician 3 Training Course
    d. Maintenance check-off Book for AN/GRC-2
    e. Maintenance Standards for Range-Azimuth Indicator, AN/SPA-4A, RCA, Navships 91825.42
    f. Maintenance Check-Off Book for Indicator Group SPA-8, 8A, 9, Navships 91411.41
    g. Maintenance and Check-Off book for Radio Sets AN/SRC 13, -14, -15, Navships 92441.42
    h. Maintenance Check-Off Book, AN/SRC-10, 10X, 10Y, 11, 11X, 12, 12X, 12Y, and AN/URC-16, 16X, 16Y, 17, 17X, 17Y, 18, 18X, 18Y, Navships 92755.41
    i. Maintenance Check-Off Book, Radio Receiving Sets. AN/SRR-1, 12, 13, Navships 91875.41
    j. Maintenance Check-off Book, Radio Transmitting Sets, AN/SRT-14, -15, -16, Navships 92121.41
    k. Maintenance Check-Off Book, Sonar Sounding Sets, AN/UQN-1B, -1C, Navships 91420.41
    l. Schedule for FRAM Mark II Sea Trial and Material Inspection, USS Cambria, 2 June 1963
    m. Material Inspection, USS Cambria, 20 May 1957
    n. Radio Interference Report, 20/27 July 1963, (date 1 August 1963) USS Cambria
    o. Maintenance Check-Off Book, Radio Transmitting Equipment Navy Model TED Series, Navships 91357.41
    p. (NOTE - All of the above were pages, not complete documents)
    q. Deposition of Robert J Kraus, 27 November 2018, 28 November 2018, 8 January 2019, 9 January 2019 with Exhibits
    r. Exhibit P5, 17 pages
    s. Gossett Notice of Deposition
    t. Landrum Notice of Deposition
    u. Deposition of Roger Gossett, 20 August 2019 with Exhibits
    v. Deposition of Joe R. Landrum, 13 August 2019, with Exhibits
19. Plaintiff Kraus, as EMO, (Officer) was not charged with physically doing work on equipment on board the USS Cambria. Physically working on the equipment was the task of the ETs. (Enlisted)

AWR

20. Plaintiff Kraus, as EMO, was in charge of the Electronic Technicians who worked on the communication and technical (Radar, Sonar, etc.) equipment on board in every location except the engine room.
21. Kraus, as EMO, had to understand the repair issues sufficiently to explain the maintenance/operational/failure issues to the chain of command (senior officers) on the vessel.
22. To accomplish Item # 21, from testimony, Kraus was frequently/constantly/in and out constantly, (verbiage from deposition testimony) around when the electronic equipment was being worked on either in the electronic repair shop or on location of radar repeaters. (The repeaters are the stand that includes the radar screen and electronic controls including capacitors and resistors, for adjustments for the radar screen.)
23. The fan in the electronic repair shop was "always" on, causing air and dust to circulate.
24. From testimony, transmitters, receivers, radios, radars, etc. contained many capacitors and resistors which resulted in high heat.
25. From supplied documentation, US Patents and Navy Specifications and letter, the resistors and capacitors contained asbestos paper for insulation and dielectric properties. (This was prevalent until the late 1960's when Nomex 410 was introduced.)
26. The Navy, in a 5 January 1979 letter to the General Accounting Office noted that asbestos was common in resistors and capacitors on all Navy ships.
27. From testimony, this paper, after use and due to heat, was easily torn, creating dust.
28. Deposition testimony includes opening of radars and antennas.
29. Asbestos gaskets were used on the antenna and radar systems, including SPS-6.
30. Typically the wires used on Navy and commercial ships through the late 1960s contained asbestos in the insulation.
31. Radars have multiple input and output signals that use wiring that terminates in the radar stands.
32. Under conditions of heat, the insulation deteriorates and becomes dusty, and the cooling fans move the resultant dust throughout the radar stands.
33. Testimony of witness shows plaintiff Kraus was close to the equipment with dust, and likely exposed to asbestos dust.
34. I am also familiar with Department of Navy Sec Nav 62603.5 later Sec. NAV 5700.5 dated 1956.
35. This document is also known as Uniform Labeling Program for Hazardous Industrial Chemicals and Materials, hereafter Uniform Labeling Program and was in place when the Plaintiff entered the Navy.
36. The Uniform Labeling Program was designed to standardize labeling requirements for hazardous products and provide labels to contain pertinent information to warn users of potential dangers.
37. The Uniform Labeling Program applied to labeling of all hazardous materials throughout the Navy.
38. The Uniform Labeling Program was not designed to govern the type of warning labels.
39. The Navy stated that the type of labels were to be governed by state and federal laws and regulations.
40. The Uniform Labeling Program noted that development of new products makes it mandatory that precautions should be taken including warning labels. (Section 3)

Aut

41. For poisons, a skull and cross bones was to be affixed.
42. Poison is defined as a substance with an inherent property that tends to destroy life or impair health. Asbestos is therefore a poison.
43. Paragraph 1.C of Uniform Labeling Program defines a Class III toxic hazard as any industrial or military material which may be given off a harmful, vapor, dust, fume or mist during handling or operation. The injurious effect may arise from one exposure (acute) or repeated exposures over a prolonged period (chronic). The mode of entry into the body maybe by ingestion, inhalation or absorption through the skins.
44. Paragraph 2.a. of the Uniform Labeling Program refers to the Warning Labeling Guide published by the Manufacturing Chemists Association.
45. This Guide, first published in 1946, requires precautionary labels for harmful dust. The reference to the guide shows the Navy's constant concern for warnings of hazards like asbestos.
46. Thus, by the time Plaintiff began his service in Norfolk in July 1964 the Navy required warnings of the hazards of asbestos in equipment for ships and that all claims that the Navy would have barred or prevented warning labels are untrue.
47. It is clear from these documents that the Navy wanted the warnings to reach Navy personnel on board the vessels and civilian personnel working on Navy ships, such as Plaintiff.
48. The Navy required manufacturers not only to warn on the products but to supply manuals containing warnings to each ship and precautions for use of the product.
49. Thus, when defendants sold products for use on ships that lacked warnings that met state and federal standards and/or the standards of the Manufacturing Chemists or the American Conference of Government and Industrial Hygienists this was in violation of specific Navy directions and requirements.
50. Rather than barring warnings, the Navy encouraged warnings, and the failure to warn of the hazards of asbestos violated Navy requirements.
51. The failure to include warnings and safety precautions in their manuals of their equipment violates specific Navy requirements.
52. The claim that the Navy would have barred warnings is thus false and without basis.
53. The Navy was well aware of the health hazards from asbestos exposure from at least 11 March 1941 and knew of discussions about the health hazards of asbestos exposure since 1939.
54. Asbestos was generally required on all high heat applications.
55. In many cases the suppliers of such equipment usually supplied asbestos product with/on/in their equipment.
56. Suppliers of equipment to the Navy were engaged by the Navy to participate in renovation and overhaul of their own equipment, or that of others, including asbestos containing parts in shipyard repairs.
57. Suppliers of equipment frequently supplied replacement asbestos or disturbed previously supplied asbestos as part of their activities on ships.
58. I expect to testify, at trial, on what the Navy archive records show about equipment supplied to the vessel, or vessels at issue, and what the records show as individual defendants supplying original or replacement asbestos containing equipment or disturbing asbestos.

Ar?

59. Generally, if a company supplied asbestos with its equipment, some of that asbestos was always present unless the record shows that the asbestos installed by the defendants was entirely removed.

60. The removal of the entire initial asbestos never occurred.

61. I cannot comment, in this affidavit, as to specific defendants whose material I have not yet examined, but will supplement my testimony at trial by reliance on the documents from the archives.

62. From testimony there were no warnings of asbestos in the training manuals for the electronic equipment on the USS Cambria.

63. From testimony, ET's were not aware of asbestos in electronic equipment during their time on board the USS Cambria.

64. From testimony, the USS Cambria underwent an overhaul that included removal and renewal of asbestos insulation on the bulkheads outside the Electronic Shop.

65. I cannot comment, in this affidavit, as to specific defendants whose material I have not yet examined. However, it is clear that asbestos was present in electronic equipment.

66. I am also prepared to discuss the use of asbestos on Navy ships.

67. I reserve the right to amend this affidavit if I am provided more information.

Sworn to and subscribed
Before me this 14th day
of October, 2019

N S BAE
NOTARY PUBLIC
STATE OF WASHINGTON
COMMISSION EXPIRES
APRIL 10, 2022

N S Bae
NOTARY PUBLIC

ARTHUR W. FAHERTY

Robson Forensic THE EXPERTS

ARTHUR W. FAHERTY, CMI
Marine Engineer and Mechanical Expert

Experienced in the installation, testing, start-up, safe operation, maintenance, modification, troubleshooting, upgrade and repair of marine and industrial machinery, equipment and systems.

Manufacturing Processes: General machining, welding, brazing, grinding soldering, oxyacetylene cutting, aligning, shrink fitting, liquid and dry filling, dry solids handling, slurry handling, liquid handling paint preparation, painting, hot tapping.

Manufacturing Procedures, Standards, and Specifications: Pressure vessels, power piping, high-pressure air compressors, low-pressure air compressors, pipe welding, structural welding, drawing standards, hazardous area requirements, electrical generation and switchboards, failure analysis.

Test Methods and Specifications: Hydrostatic testing, vibration testing, static and high speed dynamic balancing, material specifications.

Engineered Systems: Steam; condensate-steam and motor plants; condensate-landfill; feedwater; liquid fuel; natural gas; methane collection; potable water; refrigeration; salt water service; ballast; tanker cargo; fire protection; waste water; hydraulic power; pneumatic power; pneumatic controls heating; ventilation and air conditioning; bag houses; sludge; oily water; sewage; cleaning and repair of tank farm pipelines, tanks and pumps.

Machinery: Diesel engines, fuel injection equipment, high speed centrifuges, compressors, heat exchangers, refrigeration compressors, absorption and centrifugal chillers, liquid and gas fired boilers, cooling towers, air handlers, valves and fittings, turbines, turbochargers, jib cranes, monorail cranes and hoists, winches and capstans, cargo machinery, bridge cranes, industrial scales, milling machines, lathes, presses, screw conveyors, belt conveyors, roller conveyors, drive gears, clutches, distillers, reverse osmosis, spreader beams, lifting and rigging gear, horse drawn machinery, farm tractors, vactors and industrial vacuums, elevators (passenger and freight), fuel oil blending, steering gears, hydraulic rams, rotating machinery, pumps (centrifugal, reciprocating, progressive cavity, positive displacement, screw, pneumatic).

Machinery Safeguarding: Safety interlocks, failsafe modes, caution and warning signs, machine guards, drive guards, instruction manuals, controls, damage control and damage control methods.

Safety Procedures and Requirements: Material Safety Data Sheets, right-to-know, confined space entry, lockout/tagout, scaffolding, training policies, inspections, OSHA requirements, industrial cranes – shipboard, shoreside, shipyard.

Tools: Drill press, lathes, milling machines, table and radial arm saws, rotary pneumatic drills, impact wrenches, nail guns, high pressure water blasters, high pressure washers, hand tools.

Wharfinger: Duties and responsibilities.

Products: Bicycles, motorboats - gas and diesel (operation, maintenance, and repair), Alpine and Telemark skis, rope tows.

Regulatory Compliance: American Bureau of Shipping, DnV, IACS, IMO, ISM, Marpol, U.S.C.G., OSHA.

Robson Forensic THE EXPERTS

ARTHUR W. FAHERTY, CMI
Marine Engineer and Mechanical Expert

Specialized: Graving docks, floating drydocks, marine railways, shipboard automation, shipyard contracts, assessment of marine operations, U.S.C.G. License Chief Engineer Unlimited Horsepower – Motor, Third Assistant Engineer-Steam, stability/inclining experiments, marine bulkheads.

PROFESSIONAL EXPERIENCE

2006 to present — **Robson Forensic, Inc.**

Area Manager for Seattle Area 2009-present

Area Manager for Upstate/Eastern New York and Vermont 2006-2009

Provide technical investigations, analysis, reports, and testimony towards the resolution of commercial litigation cases and personal injury cases involving commercial vessels and pleasure craft.

1996 to present — **Arthur Faherty**

Consultant, Port Engineer

Work includes direct involvement with nuclear industry for safe operation of standby generators for shaft alignment, vibration problems and root cause analysis; troubleshooting large centrifugal machines for environmental clean-up in South America and purifier operations. Design work with naval architecture firm including work on installing additional engine on dynamic positioning drill vessel. All phases of shipboard operations – machinery, cargo, regulatory, human resources. Worked with German Engineering firm to market digesters for animal waste to farmers in western United States. Instructed Pipeline Hydraulics for COTCO (Cameroon Oil Transportation Company, a division of ExxonMobil), Pipeline Operators. Field Supervisors, and Pipeline Engineers for 1100 KM pipeline for pumps, pumping, hydraulic surges, system operation, testing and maintenance (Douala, Cameroon; September 2013 – July 2014).

2013 to 2014 — **Robert Allan, Ltd.**

Lead Marine Engineer

Lead Engineer for conversion of tanker to FSO for Gulf of Thailand.

1988 to 2006 — **U.S. Merchant Marine Academy, Global Maritime and Transportation School**

Visiting Professor

Areas of expertise and instruction include vibration training for nuclear power plants, shipboard propulsion systems (steam and diesel), rotating machinery (reciprocating and centrifugal pumps, centrifugal and reciprocating air compressors, centrifugal and reciprocating AC compressors, purifiers), piping systems, refrigeration, including ammonia, HVAC systems, low pressure and high pressure boiler control systems, waste treatment systems, evaporators and reverse osmosis units, Marpol regulations, Classification Society rules and regulations, electrical distribution and switchboards systems (480 and 5kV), shipboard management, shipyards, shipboard automation systems, simulation training, and failure analysis.

ARTHUR W. FAHERTY, CMI
Marine Engineer and Mechanical Expert

Programs include Ship of the Future for the U.S. Navy, MARAD Inspectors, ABS Surveyors, Diesel Engine Training for Exxon, Military Sealift Command, ARCO, License Upgrade, Diesel Generator performance for public utilities, U.S. Army Reserve Training for vessel operations, shipyard course for U.S. Navy reserve units, National Sealift Training for Engineers (both for Superintendent Engineers and for operating personnel) for hull surveys, engine room surveys and breaking out the plants and QMED program for MSC. Courses are developed using the IMO model for classroom instruction. Co-authored assessment of Staten Island Ferry System resulting in reorganization of system to reflect shipboard safety and operating standards.

2004 to 2005 **M.V. Cape Horn, Marad ROS RO/RO, 22,000 BHP**
Chief Engineer
Responsible for main propulsion engine, diesel generators, all rotating machinery including pumps, air compressors, purifiers, reciprocating AC and refrigeration compressors and all hydraulics for ramps, car decks and winches, 40 ton electro-hydraulic crane, sewage treatment plant, evaporators, interior communications and electrical switchboard and distribution. Refurbished Bridge Control system and put it in use for the first time in more than 6 years.

1998 to 1999 **Cresmont Technical Services**
Program Manager
Program Manager to design, build and operate a 3 megawatt methane-to-energy plant in Puyallup, Washington. Consultant to develop a West Coast facility for NAVSEA and MARAD vessel scrapping. Project Manager for tugboat acquisition and vessel conversion program to convert vessels into hospital ships. Consultant to bunker suppliers for fuel problems encountered on board.

1996 to 1998 **CBS Engineering, Inc.**
Senior Consulting Engineer
Construction of barges, marine issues, plant operations and plant review. Oversaw construction and delivery of $3.8M barge (400'X 100') for production platform. Responsible for operational review of 80 megawatt gas turbine power plant, centrifuge operations and mooring of barges to API specifications including design review and selection of fendering system, and strength of the docking system. Performed analysis for FPSO operations and cost for conversions in shipyards around the world.

1994 to 1996 **Wehran Energy**
Plant Manager
Ran all aspects of 2.5 megawatt methane gas to energy plant including investment to upgrade and plant expansion to 5 megawatts. Operation consisted of field expansion, field maintenance, compressing gas, flaring, condensate separation, electrical generation, pollution control and interfacing with town, county, and utility officials for upgrade and expansion.

1992 to 1994 **Fore River Shipyard & Iron Works, Inc.**
Owner
Shipyard repair and steel fabrication business. Drydocked vessels from barges to 860' SeaBee class LASH vessel. Experienced in blasting and painting of hulls and tanks, engine work, piping renewal, steel replacement, superstructure work, welding, brazing, oxyacetylene cutting and welding, machining (lathes, milling machines). Workforce of up to 128 people. Also accomplished steelwork for bridge sections and construction of barges for public authority. Accomplished design work for steam driven power barges for international power plant developer for use in South America and in the Middle East. Solved issues on delivering these plants to the various areas; this included surveying various rivers in Colombia for future installations.

1988 to 1992 **AK Engineering, Inc.**
Founder, Stockholder and Vice President
Company specialized in marine and industrial engineering projects. Responsibilities included overhaul of 6 X 6.1 Megawatt diesel generators, large oil/water separation project for utilities, ultra-high water pressure technologies for utilities and U.S. Post Office (cutting into a building in NY city while mail was being processed for expansion), very fast track construction of co-generation plant (gas driven engines with absorption and centrifugal chillers, boilers, pumps and cooling towers all controlled by pneumatic controllers). Vessel activation and deactivation for Operation Desert Storm (13 vessels).

1983 to 1988 **Various U.S. Shipping Companies**
Consultant and Chief Engineer/Fleet Engineer
Chief Engineer for three re-flaggings – two vessels were from Swedish flag to U.S. flag and one vessel was from Liberian flag to U.S. flag. Installed generator control systems to make generators fully automated. Surveyed vessels for owners to meet various RFP's with regard to budget and operational characteristics. Supervised the dry-docking of ships, accomplished troubleshooting of automation on board and provided corrective procedures, taught crews how to perform under limited manning schedules. Assumed Chief Engineer duties on poorly running vessels and returned vessels to maintenance status and in class while maintaining low overtime. Vessels included dry cargo, RO/RO, car carrier and tanker. Experienced in all types of diesel engines, generators, cranes-monorail, jib, electro-hydraulic, overhead; galley equipment including dishwashers, fryers, potato peelers, potato mashers, ovens and ventilation systems for the galleys, elevators for both people and cargo, winches, anchor handling and heat exchangers. Also experienced with impact wrenches, Sweeney wrenches, hydraulic stretching for cylinder and bearing bolts.

1978 to 1983 **Pacific Gulf Marine**
Chief Engineer on Motor Vessels
Several shipyard periods and class surveys accomplished. Vessel always remained on charter.

1971 to 1983 **Various Shipping Companies**
Various Engineering Capacities from Third Engineer to Chief Engineer
Worked on German, Japanese and American vessels. Built ships in two U.S. yards and in one Japanese yard for various owners. Officer in Charge of Ammonia Refrigeration System (2 years).

1983 **Reflag of M/V American Eagle**
Chief Engineer
Responsible for the paperwork and physical work to convert the vessel from Swedish flag to American Flag including engine room and structural steel including fabricating and welding on the aft car decks.

1978 to 1983 **Pacific Gulf Marine**
Chief Engineer on Motor Vessels
Several shipyard periods and class surveys accomplished. Vessel always remained on charter.

1976 to 1978 **Zapata Bulk Transport 4 x 40,000 Product Tanker**
Machinery Inspector/Hull Inspector/Cargo Inspector
Responsible for signing off all machinery and piping in Engine room, cargo systems including pumproom and environmental trough for Class as well as machinery, cargo systems, pump room and controls for Zapata Courier.

1974 to 1975 **New Construction, Tsuneishi, Japan for Sanko Lines, 80,000 dwt Crude Oil Tanker**
2nd Engineer
Responsible for signing off fueling stations, cargo piping and environmental trays, HFO Purifiers and main engine

1973 **New Construction of M/V Sugar Islander**
3rd Engineer
Responsible at yard for sign-off on fueling stations including environmental wells, purifiers, boiler, and evaporator at Lockheed Shipbuilding, Seattle.

PROFESSIONAL CREDENTIALS

Certified Marine Investigator, International Association of Marine Investigation, Henderson, Nevada
Chief Engineer, Unlimited Horsepower-Motor
Third Assistant Engineer
Unlimited-Steam 8th Issue, Current through April 2010

THE EXPERTS
Robson Forensic

ARTHUR W. FAHERTY, CMI
Marine Engineer and Mechanical Expert

EDUCATION

B.S., Marine Engineering, United States Merchant Marine Academy, Kings Point, NY

Additional Continuing Education:
BOAT GPS Forensic Course, National Association of State Boating Law Administrators (NASBLA), November 2018
International Association of Marine Investigators 28th Annual Training Seminar, Norfolk, VA, March 2018
ABYC (American Boat and Yacht Council) Marine Law Symposium, Charleston, SC, January 2017
Education Day with Marine Insurance Association of Seattle, 2016
Achieving Safe Permit-Required Confined Space Entries, Prospering Safely (Fred Straub), October 2013
Current Issues in Maritime Law, WSBA, October 2011
Maritime Personal Injury CLE (Lorman), Seattle, WA, July 2011
Sulzer Brothers Diesel Program, Winterthur, Switzerland

CERTIFICATIONS

ABYC (American Boat and Yacht Council) Certified Master Marine Technician
ABYC (American Boat and Yacht Council) Certified Technician – Diesel Engines – Issued 04/30/2016, expires 04/30/2021
ABYC (American Boat and Yacht Council) Certified Technician - Marine Corrosion – Issued 03/07/2014, expires 03/07/2019
ABYC (American Boat and Yacht Council) Standards Certification – Issued 06/30/2016, expires 06/30/2021
Universal Refrigeration Certification

PRESENTATIONS

Tools of the Trade, ABYC Annual Law Symposium, Seattle, Washington, January 8, 2019

CO Poisoning: Silent, Deadly and with Us All the Time (Lessons Learned from Litigation), Western Trial Lawyers Association Convention, Maui, HI, June 13, 2013

EXHIBIT I

ASBESTOS

Asbestos is used in many varied forms such as board, cloth, fiber, rope packing, sleeving, tape, twine, yarn, sheet, and in other numerous combinations. The manner of storage depends upon the form of asbestos. Where the asbestos may possibly be in a loose form during storage, a dusty condition could be produced and proper ventilation should be provided.

PROPERTIES

FIRE - Non-flammable.

EXPLOSION - Non-explosive.

BREATHING - Dust from asbestos materials may produce a chronic lung disease if it is breathed in sufficient concentrations over a period of years. In some persons, the disease may develop much more rapidly than in others. The concentration and particle size of the dust will also influence the number of years of exposure required to produce the disease. In any case, exposure even to high concentrations of asbestos dust for a period of a few days or even a few months will not produce the disease. Particles larger than about 10 microns (0.000039 in.) cannot get into the small lung air sacs to cause damage. Such small particles are far below the size which is visible to the naked eye. Most dusts, however, have particles of a large range of sizes which vary from visible to invisible. It is only the fine invisible dust particles that are effective in producing asbestosis.

Where people may breathe the dust, the Maximum Allowable Concentration is 5 million particles per cubic foot of air, unless the exposure is for less than one hour per day, in which case a slightly higher concentration may be permitted but must not exceed 10 million particles per cubic foot. These Maximum Allowable Concentrations apply to repeated or recurring daily exposures. Where asbestos may be mixed with other less harmful dusts, the concentration of asbestos dust will be the controlling factor. The asbestos dust concentration can be determined by collecting and analyzing air samples.

SKIN IRRITATION - Asbestos is usually not a skin irritant.

PERSONAL PROTECTIVE EQUIPMENT

WHEN IT IS NECESSARY TO WORK IN AN AREA CONTAINING HIGH DUST CONCENTRATIONS, AN AIR-LINE RESPIRATOR OR HOSE MASK WITH OR WITHOUT A BLOWER MAY BE USED. The air-line respirator should have 8 to 15 lbs/sq.in. pressure. Care should be taken so that contaminated air does not enter the hose for the hose mask.

For medium dust concentrations, the standard all dust respirator 8883-5, equipped with filter 8883-6, may be used. Filters should be replaced according to a predetermined schedule or at any time breathing becomes difficult.

All respirators and replacement parts should have the Bureau of Mines approval which is indicated by a label on larger parts or BM#______(approval number) on smaller parts.

PRECAUTIONS

A PERSON SHOULD NOT ENTER AN AREA CONTAINING AN EXTREMELY HIGH CONCENTRATION OF ASBESTOS DUST FOR A PROLONGED PERIOD OF TIME WITHOUT ADEQUATE PROTECTION. THE MAXIMUM ALLOWABLE CONCENTRATION

WHEN IN DOUBT
CONSULT MEDICAL OR SAFETY DEPARTMENT

ASBESTOS (Continued)

OF 5 MILLION PARTICLES OF DUST PER CUBIC FOOT OF AIR SHOULD NOT BE EXCEEDED FOR REPEATED OR CONTINUOUS EXPOSURES. THIS MAY BE ACCOMPLISHED BY COMPLETELY ENCLOSING THE SYSTEM OR BY PROVIDING ADEQUATE VENTILATION. PROPER PREPLACEMENT AND PERIODIC PHYSICAL EXAMINATIONS SHOULD BE MADE BY THE MEDICAL DEPARTMENT ON PERSONS WHO WORK WHERE THERE IS REPEATED OR RECURRING EXPOSURE TO ASBESTOS DUST.

WHEN IN DOUBT
CONSULT MEDICAL OR SAFETY DEPARTMENT

East Pittsburgh, 2-C-46
Industrial Hygiene Laboratory

June 11, 1954

PLAINTIFF'S EXHIBIT WH-350

IN RE: ABRAMS DECEMBER 1992

SOUTH PHILADELPHIA WORKS
Industrial Relations
Mr. W. E. McKeldin
Safety Supervisor

With respect to the room in which asbestos cloth is being cut and sewed, the air samples did not indicate exposure to concentrations of asbestos dust above 5 million particles per cubic foot, which is presently regarded as the maximum allowable concentration. However, I have a feeling that these concentrations may vary from time to time in the room. It would be very desirable to ventilate the room more effectively so that the amount of asbestos dust in the breathing atmosphere would be further reduced. When sheet material is being thrown from one bench to another, the concentrations of asbestos fibers in the breathing atmosphere of the sewer in particular would appear to be potentially hazardous. As you know, in the State of Pennsylvania, when a person's chest contains some silicosis and it becomes superimposed with tuberculosis, that this disease becomes compensable. I believe that the same is true in the case of asbestosis. Frequently, the early stages of asbestosis or silicosis are difficult to detect by X-rays and it is also believed that persons suffering from beginning stages of asbestosis or silicosis are more likely to develop tuberculosis. We have such a case in Compensation Court from one of our plants at the present time and they are difficult cases to handle.

As you know, the present fan in the side wall of this room is quite noisy and the men do not operate it more than necessary on account of the noise situation. Therefore, the ventilation of this room should be reconsidered. In the revision of the ventilation of this room, it might be most desirable to have the fan placed on the side of the room with the large number of windows since a good portion of the dust already is moving in this direction. It would be desirable to use a different type of fan in the improvement of this room. By placing the fan on the side wall presently containing most of the windows, the dust fibers collecting along this side of the wall would be ventilated to the outside of the building rather than dragged past the breathing level of the men doing the sewing.

I will greatly appreciate knowing what your final decision on this problem will be.

H. Wilbur Speicher, Administrator
Industrial Hygiene

P.S. These dust samples were found to contain extremely fine particles which would indicate their being more hazardous.

HWS

[redacted]

DN 65711AA-AJ - PD SPEC (PDS) -
RL Rev W
DA Mar 5, 1978

TI CABLE, ASBESTOS INSULATED

CA CAUTION: CUTTING OR MACHINING WILL PRODUCE ASBESTOS DUST. DUST SHALL NOT BE BREATHED. ADEQUATE LOCAL EXHAUST VENTILATION SHALL BE PROVIDED. SEE SPDS A-20.

SU SUPPLIERS:

(65711AA)		A-B-D-E-F-G
(65711AB)		A-B-C-D-E-F-G
(65711AC)		C-D
(65711DJ)	(All Plants except Elevator)	A-B-D
	(Elevator)	A-B-D-H

(A) Cerro Wire and Cable Co (Cerro) 550 Nicoll St, New Haven, CT 06504
(B) Coleman Cable Co, 1900 N Fifth Ave, River Grove, IL 60161
(D) Continental Wire and Cable Corp (Anaconda) Gelton Rd, York, P 17404
(E) Okonite Co, PO Box 340, Ramsey, NJ 07446
(F) Phelps Dodge Cable and Wire Co, Foot of Point St, Yonker, NY 10702
(G) Rudix Wire Co, 26245 Lakeland Blvd, Cleveland, OH 44132
(H) United States Steel Corp (Wire and Cable Div) Ballard St, Worchester, MA 01607

OR ORDER FROM SUPPLIER AS: Cable (or Wire), stating P D Spec Number and Rev Letter.

CH CHARACTERISTICS:

Grade	Previous Grade	Users	Insulation	Treated Braid
65711AA	7419-2	BG BS EP JC MAR SDD	VC & Asb	Asbg
65711AB	7419-3	BG BS EP JC LAE PT PTR SH	Asb	Asbg
65711AC	7419-4	NE	Asb	Asb
65711AD	7419-5		Obsolete.	
65711AE	7419-8		Obsolete.	
65711AF	7419-12		Obsolete.	
65711AG	7419-15		Obsolete.	
65711AH	7419-18		Obsolete.	
65711AJ	7419-1	BE BG BS EP JC NE SDD	VC & Asb	Cottong

[redacted]

Grade	Braide Color	Type	Voltage^
65711AA	Black	AVA	600
65711AB	Black	AIA	600
65711AC	Black	AIA	600
65711AD			
65711AE			
65711AF			
65711AG			
65711AH			
65711AJ	Gray	AVB	600

Tinned copper wire, except 65711AB has untinned conductor
* Unless otherwise specified.
\# Contains fungicide.
^ Circuit voltage, phase to phase.

AP APPLICATION:
(65711AA,AJ) Switchboard and control wiring.
(65711AB,AC) Apparatus leads; general use.

CP CORPORATE PART NUMBER: PDS No. + Size Code
Example: 65711AA5SL (CABLE - If reference name is desired)

PDS 42331AA thru AC Rev AA Jul

ASBESTOS PAPER

CAUTION: DUST RESULTING FROM HANDLING OR MACHINING SHALL NOT BE BREATHED. USE ONLY WI
LOCAL EXHAUST VENTILATION. SEE SPDS A-20.

SUPPLIERS -

(42331AA)	(Except .007" & .010" thk)		A-B
	(.007" thk only)		B
	(.010" thk only)	(Except HA)	B
		(For HA)	A-B

(A) Johns-Manville, Greenwood Plaza, Denver, CO 80217
(B) Nicolet, Inc, Wissahickon Ave, Ambler, PA 19002

ORDER FROM SUPPLIER AS - (42331AA) Paper, P D Spec 42331AA Rev AA.

CHARACTERISTICS - 42331AA (Previous 2118-1)(Users:AMD,BE,BG,BM,BMM,DA,EP,HA,M&R,PT,SH,SM
Commerical grade asbestos paper of uniform quality.
42331AB (Previous 2118-2) Obsolete.
42331AC (Previous 2118-3) Obsolete.

For properties & dimensions see PDS.

APPLICATION - General use.

SPECIFY BY - CODED IDENT (PDS No. + Size Code)
Example: 42331AA3GD (ASB PAPER - If reference name is desired)

M 46316AJ thru AM Rev B Jul 20, 1976

MOLDED PARTS, CALCIUM SILICATE-ASBESTOS
CAUTION: MACHINING PRODUCES ASBESTOS DUST. DUST SHALL NOT BE BREATHED. ADEQUATE LOCAL EXHAUST VENTILATION SHALL BE PROVIDED. SEE SPDS A-20.
SUPPLIERS - American Insulator Corp, 1930 Main St, New Freedom, PA 17349

ORDER FROM SUPPLIER AS -
(46316AJ,AL,AM) AICO 5, stating drawing and item number.
(46316AK) AICO 5 plus 1.5% Carbon Black, stating drawing and item number.

CHARACTERISTICS - 46316AJ (Previous 161-1)(User:BG) White, inorganic, cold molded composition consisting of calcium silicate and asbestos, having properties as follows:

Tensile Strength, Psi	2200
Compressive Str, Psi	10910
Flexural Strength, Psi	3783
Impact Str, Ft-Lb/In-Notch	.46
Dielectric Strength, VPM	43
Arc Resistance, Sec	556
Heat Resistance, F	1000
Specific Gravity	1.84
Moisture Abs, 24 hr, %	4-13

CANCELLED 6-20-84

46316AK (Previous 161-2)(User:BG) Same as 46316AJ except black. Contains 1.5% carbon black.
46316AL,AM (Previous 161-3,-4)(User:BG) Same as 46316AJ except for specific applications.

APPLICATION - (46316AJ) Intricate inorganic cold molded parts.
(46316AK,AL) Cold molded parts such as arc boxes.
(46316AM) Cold molded insulating spacers for rotary switches.

SPECIFY BY - CODED IDENT (M No.)
Example: 46316AJ (SILICATE ASB - If reference name is desired)

30071419

M 41521CC Rev B OBS./CANCELLED 5/5/78 Jul 5, 1976

WESTINGHOUSE PROPRIETARY

CLOTH, ASBESTOS, SILICONE VARNISH TREATED

CONVERTED TO

CAUTION: DUST RESULTING FROM HANDLING OR MACHINING SHALL NOT BE BREATHED. USE ONLY WITH ADEQUATE LOCAL EXHAUST VENTILATION. SEE SPDS A-20.

SUPERSEDED BY................

SUPPLIERS - Westinghouse Electric Corp, IMD, Bedford, PA 15522

ORDER FROM SUPPLIER AS - Treated Cloth 41521CC*

*Stating "Permanently mark all containers with Westinghouse M number."

CHARACTERISTICS - (Previous 1296-1)(User:M&R) Asbestos cloth 41511BB treated with silicone varnish 32102FH.

APPLICATION - Armature insulation.

SPECIFY BY - CODED IDENT (M No. + Size Code)
Example: 41521CC1JX (TR ASB CLOTH - If reference name is desired)

Printed in U.S.A. W Corp Std R&D (Fed. CODE IDENT NO. 79500)

DN [redacted] - PD SPEC (PDS) -
RL Rev A
DA Jul 5, 1976
-
TI ASBESTOS TAPE, WOVEN
-
CA CAUTION: DUST RESULTING FROM HANDLING OR MACHINING SHALL NOT BE BREATHED. USE ONLY WITH ADEQUATE LOCAL EXHAUST VENTILATION. SEE SPDS A-20.
-
SU SUPPLIERS:
(A) Amatex Corp, 1030 Stanbridge St, Norristown, PA 19404
(B) Atlas Textile Co, 538 Walnut St, North Wales, PA 19454
(C) H K Porter, Inc, 1000 Seaboard St, Charlotte, NC 28206
(D) Raybestos-Manhattan, Inc, 100 Oakview Dr, Trumbull, CT 06611
(E) Uniroyal, 1230 Ave of Americas, NY, NY 10020
-
(.010" thk)	A-B-E
(.015", .025" thk)	A-B-C-D-E

-
OR ORDER FROM SUPPLIER AS: Tape, P D Spec 41511AA Rev A.
-
CH CHARACTERISTICS: (Previous 1598) (Users: BM EP JC MAR PT SH) Closely woven, unsized asbestos tape, .010", .015" and .025" thk. Tape .015" thk and over is constructed of asbestos yarns, both warp and fill, which may contain 20% (max) cotton. Tape .010" thk contains in addition to asbestos warp yarns two cotton threads at each edge and filler is of fine cotton yarn. Cotton content of asbestos warp threads is approx 17% and total percentage of cotton is approx 27%.
-
For additional properties and construction details see PDS.
-
TL TOLERANCES: See PDS
-
EQ EQUIVALENTS(ref only): MIL-I-3053, tape. grade U.G., type 2PU
-
TRADENAMES: MIL I 3053 GR U G TYPE 2PU
-
AP APPLICATION: Taping TI 130 armature coils.
-
CP CORPORATE PART NUMBER: PDS No. + Size Code
Example: 41511AA1BM (ASB TAPE - If reference name is desired)
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DN 42231AA-AB — PD SPEC (PDS) —
RL Rev D
DA Jan 20, 1977

TI ABESTOS PAPER

CA CAUTION: DUST RESULTING FROM HANDLING OR MACHINING SHALL NOT BE BREATHED. USE ONLY WITH ADEQUATE LOCAL EXHAUST VENTILATION. SEE SPDS A-20.

SU SUPPLIERS:
(42231AA) Johns-Manville, Greenwood Plaza, Denver, CO 80217

OR ORDER FROM SUPPLIER AS: (42231AA) Paper, P D Spec 42231AA Rev D.

CH CHARACTERISTICS: 42231AA (Previous 4262-1) (User: BM BMM CL EP M&R TM) High grade asbestos paper composed of nonferrous type asbestos fiber specially manufactured to be free from conducting particles. It is much freer from conducting particles than commercial asbestos paper 42331AA and is considerably more expensive.

Thk, Inch.	Tens Str, Min (Lb/In Width)		Tear Str, Min (Gm/In. Width)		Apparent Density Grams/cc		Basis Weight, Lb/100 Sq Ft	
Nom	MD	CMD	MD	CMD	Min	Max	Min	Max
0.005	12	7	20	28	.65	.91	1.7	2.3
.0065	15	9	28	39	.76	.89	2.4	3.1
.007	17	10	29	40	.69	.95	2.9	3.5
.010	20	12	40	47	.67	.92	3.6	4.8
.015	23	13	62	77	.69	.94	5.5	7.5

42231AB (Previous 4262-2) Obsolete.

TL TOLERANCES: See PDS

EQ EQUIVALENTS(ref only): MIL-I-3053, type 2PU
TRADENAMES: MIL I 3053 TYPE 2PU QUINORGO 4000

AP APPLICATION: Treated with shellac for field coil insulation.

CP CORPORATE PART NUMBER: PDS No. + Size Code
Example: 42231AA18Q (ASB PAPER - If reference name is desired)